EXHIBIT 25

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

TQ DELTA, LLC,
Plaintiff,
v.

COMMSCOPE HOLDING COMPANY, INC., COMMSCOPE INC., ARRIS INTERNATIONAL LIMITED, ARRIS GLOBAL LTD., ARRIS US HOLDINGS, INC., ARRIS SOLUTIONS, INC., ARRIS TECHNOLOGY, INC., and ARRIS ENTERPRISES, LLC,
Defendants.

CIV. A. NO. 2:21-CV-310-JRG
(Lead Case)

TQ DELTA, LLC,
Plaintiff,
v.

NOKIA CORP., NOKIA SOLUTIONS AND NETWORKS OY, and NOKIA OF AMERICA CORP.,
Defendants.

CIV. A. NO. 2:21-CV-309-JRG
(Member Case)

NOKIA OF AMERICA CORP.,
Third-Party Plaintiff,
v.

BROADCOM CORP., BROADCOM INC., and AVAGO TECHNOLOGIES INTERNATIONAL SALES PTE. LTD.,
Third-Party Defendants.

DECLARATION OF RICHARD D. WESEL, PH.D.
<u>REGARDING CLAIM CONSTRUCTION</u>

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I. INTRODUCTION

1. My name is Richard D. Wesel, Ph.D., and I have been retained as a technical expert by counsel for Defendants Nokia of America Corporation, Nokia Corporation, Nokia Solutions and Networks Oy (collectively, "Nokia") and CommScope Holding Company, Inc., CommScope Inc., ARRIS US Holdings, Inc., ARRIS Solutions, Inc., ARRIS Technology, Inc., and ARRIS Enterprises, LLC (collectively, "CommScope") (together, "Defendants") to address certain issues concerning U.S. Patent No. 7,844,882 (the "'882 Patent"), U.S. Patent No. 8,276,048 (the "'048 Patent"), U.S. Patent No. 8,495,473 (the "'5473 Patent"), U.S. Patent No. 9,547,608 (the "'608 Patent"), and U.S. Patent No. 10,409,510 (the "'510 Patent") (collectively, "Family 3 Patents"), as well as U.S. Patent No. 8,595,577 (the "'577 Patent"), U.S. Patent No. 9,904,348 (the "'348 Patent"), U.S. Patent No. 9,485,055 (the "'055 Patent"), U.S. Patent No. 10,044,473 (the "'4473 Patent"), U.S. Patent No. 10,833,809 (the "'809 Patent"), and U.S. Patent No. 8,468,411 (the "'411 Patent") (collectively, "Family 9 Patents"), which have been asserted by TQ Delta, LLC ("Plaintiff" or "TQ Delta"). Unless otherwise stated, the matters contained in this declaration are of my own personal knowledge and, if called as a witness, I could and would testify competently and truthfully with regard to the matters set forth herein.

2. My opinions are based on my years of education, research and experience, as well as my investigation and study of relevant materials. A list of materials considered is included in **Exhibit A** to my declaration.

3. I may rely on these materials, my knowledge and experience, and/or additional materials, documents, and information in forming any opinions in this Action, including but not limited to opinions to rebut arguments raised by Plaintiff. I reserve all rights that I may have to supplement this declaration if further information becomes available or if I am asked to consider

additional information. Furthermore, I reserve all rights that I may have to consider and comment on any additional expert statements or testimony of Plaintiff's experts in this matter.

4. My analysis of materials relevant to this Action is ongoing, and I may continue to review new material as it becomes available. This declaration represents only those opinions I have formed to date. I reserve the right to revise, supplement, and/or amend my opinions stated herein based on new information and on my continuing analysis of the materials already provided. I also reserve the right to create exhibits to use in Court if called upon to testify.

5. I am being compensated at my usual consulting rate of $600 per hour for my time spent working on issues in this case. My compensation does not depend upon the outcome of this matter or the opinions I express.

II. QUALIFICATIONS

6. I have summarized in this section my educational background, work experience, and other relevant qualifications. A true and accurate copy of my curriculum vitae is attached as **Exhibit B** to this declaration.

7. I have over 30 years of experience in communications and signal processing. I am a professor in the Electrical and Computer Engineering Department of UCLA as well as the Associate Dean for Academic and Student Affairs of the Henry Samueli School of Engineering and Applied Science. After receiving bachelors and master's degrees in Electrical Engineering from MIT in 1989, I worked at AT&T Bell Laboratories from 1989 to 1991 as a Member of Technical Staff performing research and development in telecommunications. I attended Stanford University from 1991 to 1996, receiving my Ph.D. in Electrical Engineering in 1996. Upon receiving my Ph.D. I joined the faculty of the UCLA Electrical Engineering Department, where I have been teaching and doing research on communications and signal processing for the last 24

years.

8. I have extensive experience researching and teaching communications techniques including multi-carrier modulation, interleaving, and error control coding in general as well as Reed-Solomon coding in particular. My publications and patents are listed in my curriculum vitae . I have published over 200 conference and journal publications, and I am the inventor on nine patents. I have received the National Science Foundation (NSF) CAREER Award and an Okawa Foundation award for research in information theory and telecommunications. I am a Fellow of the Institute of Electrical and Electronics Engineers (IEEE). I previously served as an Associate Editor for Coding and Coded Modulation for the IEEE Transactions on Communications. I currently serve as an Associate Editor for Coding and Decoding for the IEEE Transactions on Information Theory.

9. I authored an Asilomar conference paper in 1995 entitled "Fundamentals of Coding for Broadcast OFDM" that discusses techniques for designing coding and modulation for multicarrier transmission with interleaving. My 1996 Ph.D. dissertation included the design of trellis codes for multicarrier transmission with interleaving. In a 1999 Communications Letter, I presented related results on trellis codes for multicarrier transmission with interleaving. In a 2000 IEEE Transactions on Communications paper, I compared the performance of these new codes to Reed-Solomon codes used on multicarrier transmission with interleaving. I also authored several conference papers in the late 1990's related to coding for multicarrier transmission with interleaving including "Joint Interleaver and Trellis Code Design," "Periodic Symbol Puncturing of Trellis Codes," and "Trellis Codes for Compound Periodic Gaussian Channels."

10. I authored the chapter entitled "Error Control" in the book Wireless Multimedia Communications: Networking Video, Voice, and Data in 1997, which discussed the concepts of

Reed-Solomon codes and interleaving. This book also discusses multicarrier modulation in Section 3.4 and Section 5.2.

11. I am an inventor on U.S. Patent No. 6,125,150 entitled "Transmission System using Code Designed for Transmission with Periodic Interleaving," which discloses, among other things, error control techniques for multicarrier transmission with interleaving. I am also an inventor on U.S. Patent No. 6,158,041 filed in October 1998 entitled "System and method for I/Q Trellis Coded Modulation" which also describes, among other things, error correction coding techniques for multicarrier transmissions using interleaving.

12. A complete list of cases in which I have testified at trial, hearing, or by deposition within the preceding five years is attached as **Exhibit C** to my declaration.

13. Based on my education and experience, I believe I am qualified to render the opinions set forth here.

III. SCOPE OF OPINIONS

14. I have been asked to provide opinions regarding the meaning of certain disputed claim terms as understood by one of ordinary skill at the time of the claimed inventions. My opinions are based on my understanding of the disputed claim terms and proposed construction and the evidence relied upon by the parties.

IV. LEGAL STANDARDS RELIED UPON

15. Certain legal principles that relate to my opinions have been explained to me by counsel.

16. I understand that ultimately the Court will determine how specific terms shall be construed. The intent of this declaration is to help inform the Court how a person of ordinary skill in the art would have understood the meaning of certain disputed claim terms at the time of the

claimed inventions in the context of the Asserted Patents' claims, specifications, and prosecution histories in a manner that will assist the Court in the process of construing the claims. I understand that patent claims are generally given the meaning that the terms would have to a person of ordinary skill in the art in question as of the earliest claimed priority date. It is my understanding that a patentee can act as its own lexicographer by defining a term, in the patent specification, to have specific meaning. It is my understanding that statements made to the patent office by the patentee or its legal representative during prosecution can serve to illuminate, or possibly narrow the proper scope of claim terms, and that such statements must be considered when construing the claim terms. This is sometimes referred to as disclaimer. I have taken into account these principles in my analysis.

17. I understand that a claim is indefinite if, when read in light of the specification and its prosecution history, the claim fails to inform, with reasonable certainty, those skilled in the art about the scope of the claimed invention.

18. I understand that a patent may include both independent and dependent claims. I understand that a claim in dependent form must contain reference to a claim previously set forth and then specify a further limitation of the subject matter claimed. A claim in dependent form must be construed to incorporate by reference all the limitations of the claim on which it depends.

V. BACKGROUND

A. Family 3 Patents

19. I have been asked to provide opinions regarding the meaning of certain claim terms in the '882 Patent, '048 Patent, '5473 Patent, '608 Patent, and the '510 Patent.

20. Each of the Family 3 Patents is titled "Resource sharing in a telecommunications environment."

21. I understand that TQ Delta has asserted the following claims and priority dates:

Patent	Asserted Claims	Asserted Priority Date
’882 Patent	9, 13, 14, 15	October 12, 2004
’048 Patent	1, 5, 6, 7	October 12, 2004
’5473 Patent	10, 28, 36	October 12, 2004
’608 Patent	2, 3, 4	October 12, 2004
’510 Patent	21, 22, 23	October 12, 2004

22. I have been asked to assume the applicability of the priority dates for these patents as detailed above and have therefore analyzed the claim constructions and knowledge of one of ordinary skill for the patents as of those dates.

23. In forming the opinions set forth in this declaration, I have reviewed the asserted Family 3 Patents, the relevant file histories, as well as the Provisional Application No. 60/618,269, the provisional application to which the Family 3 Patents claims priority.

24. The Family 3 Patents, which share a common specification, are generally directed to sharing a common memory and allocating that common memory between an interleaver and a deinterleaver in digital subscriber line (“DSL”) technology. *See* ’882 Patent at Abstract. As an example, the ’882 Patent admits that interleaving and Reed-Solomon coding were known in the prior art but that the memory requirements were burdensome. *Id.* at 1:49–55. Accordingly, the ’882 Patent explains that “an exemplary aspect of this invention relates to sharing memory between one or more interleavers and/or deinterleavers in a transceiver.” *Id.* at 1:56–58.

25. With respect to the background of the invention, I reserve the right to respond to TQ Delta’s expert’s description should a more detailed description of memory allocation between an interleaver and deinterleaver become available.

B. Certain Family 9 Patents

26. I have been asked to provide opinions regarding the meaning of certain claim terms in the ’577 Patent, ’348 Patent, and the ’809 Patent (“Certain Family 9 Patents”).

27. Each of the ’577 and ’348 Patents is titled “Packet retransmission.” The ’809 Patent is titled “Techniques for packet and message communication in a multicarrier transceiver environment.”

28. As to only the Certain Family 9 Patents, I understand that TQ Delta has asserted the following claims and priority dates:

Patent	Asserted Claims	Asserted Priority Date
’577 Patent	16, 17, 18, 30, 31, 32, 37, 38, 39, 44, 53, 54, 55, 60	April 12, 2006
’348 Patent	1, 2, 3, 4, 9, 10, 11, 12	April 12, 2006
’809 Patent	1, 2, 3, 4, 6, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 20, 22, 23, 24, 25, 27	April 12, 2006

29. I have been asked to assume the applicability of the priority dates for these patents as detailed above and have therefore analyzed the claim constructions and knowledge of one of ordinary skill for the patents as of those dates.

30. The Certain Family 9 Patents share a common specification. For the purposes of this Background section, I use the ’348 as the representative patent of the Certain Family 9 Patents. I will now describe the ’348 Patent below.

31. Entitled “Packet Retransmission,” the ’348 Patent issued on July 28, 2015. *See* ’348 Patent, Front Page. I understand that the U.S. Non-Provisional Patent application that was eventually granted as the ’348 Patent was U.S. Non-Provisional Patent App. No. 14/075,194, entitled “Packet Retransmission” and filed November 08, 2013 with an earliest priority date of April 12, 2006. *Id*. More specifically, I understand the following:

- U.S. Non-Provisional Patent App. No. 14/075,194 was a continuation of U.S. Non-Provisional Patent App. No. 12/760,728, entitled “Packet Retransmission,” filed on April 15, 2010, and granted on November 26, 2013 as U.S. Patent No. 8,595,577. *Id.*

col. 1:05–18.

- U.S. Non-Provisional Patent App. No. 12/760,728 was a divisional of U.S. Non-Provisional Patent App. No. 12/295,828, entitled "Packet Retransmission and Memory Sharing," filed on October 02, 2008, and granted on December 18, 2012 as U.S. Patent No. 8,335,956. *Id*.

- U.S. Non-Provisional Patent App. No. 12/295,828 was a national stage entry of P.C.T. International Patent App. No. PCT/US2007/066522, entitled "Packet Retransmission and Memory Sharing," filed on December 04, 2007, and claiming priority to U.S. Provisional Patent App. Nos. 60/849,650 and 60/792,236, filed October 05, 2006 and April 12, 2006, respectively. *Id*.

32. For purposes of this Declaration, I use April 12, 2006 as the priority date of the '348 Patent. The materials I have considered predate the Certain Family 9 Patents' priority date.

33. The '348 Patent generally relates to pre-existing telecommunications technologies and noise mitigation techniques, including error correction coding (also referred to as forward error correction (FEC) coding), error detection coding, interleaving, and retransmission. The specification identifies the field of the invention as "retransmission of packets in a communication environment" and "memory sharing between transmission functions and other transceiver functions." *Id*. at 1:24–29. It further explains that the transceiver operates using "well known componentry" for DSL systems. *Id.* at 9:59–10:5.

34. Retransmission is a well-known technique where the transmitter retains the transmitted information to await a feedback message from the receiver. If the message indicates unsuccessful reception (a negative acknowledgement or NACK), the transmitter will transmit the information again. If the message indicates successful reception (an acknowledgement or ACK),

retransmission will not be needed and the transmitted information no longer needs to be retained.

35. Retransmission can be used in conjunction with the techniques of error detection coding, error correction coding, and interleaving/deinterleaving. With well-known error detection coding such as a Cyclic Redundancy Check (CRC) code, an error detection encoder at the transmitter converts a sequence of input data symbols into a longer sequence of codeword symbols, for example by appending CRC bits or symbols to the input sequence. Then, an error detection decoder at the receiver can detect the presence of errored symbols, for example when the received CRC is not consistent with the input sequence to which it is appended. At the receiver, the results of the error detection decoder can be used, for example, to decide whether to send an ACK or a NACK.

36. With well-known error correction encoding such as Reed-Solomon encoding, an error correction encoder at the transmitter converts a sequence of input data symbols into a longer sequence of codeword symbols, for example by appending Reed-Solomon parity symbols to the input sequence. Then, an error correction decoder at the receiver can correct up to a certain number of errored symbols based on the special structure imposed by the error correction code. With the well-known technique of interleaving/deinterleaving, an interleaver at the transmitter rearranges the order of the symbols to spread out the symbols of each codeword across the sequence of transmitted symbols. A deinterleaver at the receiver returns the symbols to their original pre-interleaving order so that they can be properly understood by the error correction and/or error detection decoders. Interleaving/deinterleaving is beneficial in combating bursts of errors in the channel by distributing the errored symbols to multiple error correction codewords.

VI. LEVEL OF ORDINARY SKILL IN THE ART

37. I have been asked to offer my opinion regarding the level of ordinary skill in the art

with respect to each of the Asserted Patents.

38. In my opinion, with regard to the Family 3 Patents, a person of ordinary skill in the art ("POSITA") would have had at least a Bachelor's degree in electrical engineering, or a related field, and at least 6–7 years of experience in telecommunications or a related field; a master's degree in electrical or computer engineering, or the equivalent, and at least 4–5 years of experience in telecommunications or a related field; or a Ph.D. in electrical or computer engineering, or the equivalent, with at least 1–2 years of experience in telecommunications or a related field. As of the time of the invention of the various patents, I qualify as a person of ordinary skill in the art.

39. With regard to the Certain Family 9 Patents, a POSITA would have had a bachelor's degree in electrical or computer engineering (or a similar field) and 3-5 years of experience in communications systems. A higher degree (such as a master's or doctoral degree) in electrical or computer engineering could substitute for work experience; for example, a person with a master's degree in electrical engineering with 1-2 years of experience in communications systems would also qualify as a POSITA. As of the time of the invention of the various patents, I qualify as a person of ordinary skill in the art.

VII. DISPUTED CLAIM TERMS

40. I have been asked to provide opinions as to the terms and issues identified below and the claims associated with those terms.

A. Family 3 Patents

1. "shared memory" / "sharing the memory" / "operable to be shared" / "sharing"

Claim(s)	Plaintiff's Position	Defendants' Position
'882 Patent, Claims 9, 13 '048 Patent, Claims 1, 5	"common memory used by at least two functions, where a portion of the memory can be used by either one of the functions"	Plain and ordinary meaning

’5473 Patent, Claims 10 ’510 Patent, Claims 21, 22 ’608 Patent, Claim 2		

41. I understand that the parties dispute the construction of “shared memory” / “sharing the memory” / “operable to be shared” / “sharing” (collectively, the “shared memory” limitation), which appears in the above-listed claims of the ’882 Patent, the ’048 Patent, the ’5473 Patent, the ’510 Patent, and the ’608 Patent. I understand that the Plaintiff contends that this term be construed to mean “common memory used by at least two functions, where a portion of the memory can be used by either one of the functions.” I understand that the Defendants contend that these terms should be afforded their plain and ordinary meaning. Having considered the parties’ positions, I agree with Defendants’ interpretation.

42. It is my opinion that the shared memory limitation should not be narrowed to mean “common memory used by at least two functions, where a portion of the memory can be used by either one of the functions” as proposed by the Plaintiff. As an initial matter, persons of ordinary skill in the art at the time of the invention would have known, without the benefit of a construction, what a “shared memory” is. The construction as proposed by Plaintiff injects unnecessary confusion into a term that was well known in the art. Indeed, shared memory is a well-known concept known well before the priority date of the Family 3 Patents. For example, during prosecution of each of the Family 3 Patents, the Examiner considered and addressed U.S. Patent No. 6,707,822 to Fadavi-Ardekani, et al., which was filed on January 7, 2000 and issued as a U.S. Patent on March 16, 2004. As to the ’882 Patent, the Examiner allowed the claims of the ’882 Patent over Fadavi-Ardekani but explained that Fadavi-Ardekani “discloses sharing a memory

between the interleavers and deinterleavers." '882 File History, Notice of Allowance dated October 6, 2010. It thus makes little sense to define a term that was well known by persons of ordinary skill in the art.

43. Additionally, Plaintiff's construction appears to narrow the term "shared memory" to exclude certain embodiments that a POSITA would have recognized to be a shared memory. With random access memories (RAMs), for example, the location where bytes or words of memory are written or read is provided to an address register, and functions are often allocated memory space by assigning to the function a range of addresses. In these circumstances, it might be that multiple functions share the RAM but input addresses into the register and are assigned so that the functions use the memory space without ever using the same portion of memory even though the functionality of the RAM makes it possible and easy for multiple functions to use the same portion of memory. In cases like this, it would be unclear whether, under Plaintiff's construction that requires that "a portion of the memory can be used by either one of the functions," such a memory would meet those requirements.

44. As another example, in digital signal processing chips (DSPs), numerous functions access a single memory resource. Those numerous functions share the same memory regardless of whether memory locations are used to support multiple functions or not. A POSITA would have known that these functions share the common memory of the DSP even though the POSITA may not have immediately known whether the DSP was programmed so that multiple functions actually access the same location in the common memory. Here again, it is unclear whether "a portion of the memory can be used by either one of the functions," even though a POSITA would have recognized that the memory is shared.

45. With both of these examples, multiple functions share a memory whether or not a

portion of memory is used by more than one function. Whether to use the same location of memory for multiple functions is a choice that a person of ordinary skill in the art makes about how to use a shared memory rather than a defining characteristic of a shared memory. The plaintiff's construction leads to unnecessary confusion as to whether a portion of the memory can be used by either one of the functions. For example, when two functions share the same RAM, but the application only requires a one-time allocation of memory to each of the two functions, the fact that the shared memory is only allocated once does not change the fact that it is shared. As Plaintiff's proposed construction merely causes confusion where none previously existed, shared memory should be construed as its plain and ordinary meaning.

2. "wherein the generated message indicates how the memory has been allocated between the [first deinterleaving / interleaving] function and the [second] deinterleaving function" / "a message indicating how the shared memory is to be used by the interleaver or the deinterleaver"

Claim(s)	Plaintiff's Position	Defendants' Position
'5473 Patent, Claims 10, 28	Plain and ordinary meaning.	Plain and ordinary meaning, which is that the message indicates the amount of memory [that has been allocated to / is to be used by] the [first deinterleaving / interleaving] function and the amount of memory [that has been allocated to / is to be used by] the [second] deinterleaving function

46. I understand that the parties dispute the construction of "wherein the generated message indicates how the memory has been allocated between the [first deinterleaving / interleaving] function and the [second] deinterleaving function" and "a message indicating how the shared memory is to be used by the interleaver or the deinterleaver," which is in the above-listed claims of the '5473 Patent. I understand that the Plaintiff contends that this term should be afforded its plain and ordinary meaning, while Defendants contend that this term should be

afforded its plain and ordinary meaning as well, which is that the message indicates the amount of memory [that has been allocated to / is to be used by] the [first deinterleaving / interleaving] function and the amount of memory [that has been allocated to / is to be used by] the [second] deinterleaving function." Having considered the parties' positions, I agree with Defendants' interpretation and agree that their expression of the plain and ordinary meaning is correct.

47. It is my opinion that the limitations "wherein the generated message indicates how the memory has been allocated between the [first deinterleaving / interleaving] function and the [second] deinterleaving function" and "a message indicating how the shared memory is to be used by the interleaver or the deinterleaver" should be afforded their plain and ordinary meaning. When read in light of the specification and file history, the plain and ordinary meaning of those terms is "the message indicates the amount of memory [that has been allocated to / is to be used by] the [first deinterleaving / interleaving] function and the amount of memory [that has been allocated to / is to be used by] the [second] deinterleaving function."

48. In my opinion, a person of ordinary skill in the art reading the limitation in the context of the claims would have read the term "indicates/indicating how" to mean indicating an amount of memory. For example, reading claim 10, it generally recites a transceiver with a shared memory, sharing that memory between an interleaver and deinterleaver, and, in a message, indicating how the shared memory is to be used. A person of ordinary skill in the art would have read "indicating how the shared memory is to be used" to mean indicating the amounts of memory that are to be used by the interleaver and deinterleaver. Likewise, reading claim 28, it recites that a portion of the memory may be allocated to the interleaver and the deinterleaver, and a message that indicates how the memory has been allocated between the interleaver and deinterleaver. A POSITA would have read "indicates how the memory has been allocated" to mean indicates the

amount of memory that has been allocated. Therefore, a person of ordinary skill in the art, reading the language in the context of the claims, would have understood that the plain and ordinary meaning of indicating how the shared memory is to be used would be indicating an amount of memory to be used.

49. Reading the specification, I do not believe there is any other logical conclusion. A person of ordinary skill in the art would read the specification and would find no examples of *how* memory is used beyond an indication of the amount of memory that is used. For example, the specification provides three examples of the contemplated invention. In the first example, the memory is referenced in relation to allocating "16 Kbytes of interleaver memory," allocating "4 Kbytes of interleaver memory" and sharing a "memory space containing at least (16–4)=20 Kbytes." '882 Patent at 6:24–67. In the second example, the memory is referenced in relation to "4 Kbytes of interleaver memory" and a "memory space containing at least 3*4=12 Kbytes." *Id.* at 7:10–28. In the third example, the memory is referenced in relation to "10 Kbytes of interleaver memory" resulting in "20K of shared memory." *Id.* at 7:29–49.

B. Certain Family 9 Patents

1. "wherein the transceiver is operable to receive at least one retransmitted packet using interleaving"

Claim(s)	Plaintiff's Position	Defendants' Position
'577 Patent, Claims 17, 31	No construction needed.	Indefinite

2. "wherein the instructions further cause the transceiver to retransmit the packet using forward error correction decoding and deinterleaving."

Claim(s)	Plaintiff's Position	Defendants' Position
'809 Patent, Claim 24	No construction needed.	Indefinite

3. "receive at least one message without using interleaving"

Claim(s)	Plaintiff's Position	Defendants' Position
'577 Patent, Claims 37, 53	No construction needed.	Indefinite

50. I understand that the parties dispute the construction of the above-identified phrases in the above listed claims of the '577 and '809 Patents. I understand that the Plaintiff contends that each of the phrases requires no construction. Having considered the parties' positions, I agree with Defendants' interpretation that each of the phrases is indefinite. As I explain below, it is my opinion that a POSITA would not have understood what is meant by this term.

51. As discussed above in the background, there are a variety of techniques that transceivers use to improve the reliability of data transmission, including error correction, error detection, retransmission, and interleaving/deinterleaving. For each of these techniques, there is a function or operation performed by the transmitter portion of the transceiver at one end of the connection and a corresponding but distinct function or operation performed by the receiver portion of the transceiver at the other end of the connection. The table below presents examples of the transmitter and receiver functions for examples of a variety of techniques.

Technique	Transmitter operation	Receiver operation
Error correction Example: Reed-Solomon Coding	Encoder converts an input sequence of symbols into a longer sequence of coded symbols according to an error correction encoding rule.	Decoder finds the sequence of input symbols that is the best guess based on the (possibly corrupted) received sequence of coded symbols and the encoding rule.
Error Detection Example: Cyclic Redundancy Check Coding	Encoder converts a sequence of input symbols into a longer sequence of symbols according to an error detection encoding rule.	Decoder determines whether the (possibly corrupted) received sequence obeys the rule. If so, it validates the corresponding sequence of information data symbols. If not, it declares an

		error.
Retransmission based on feedback	Retransmission at the transmitter retains the transmitted sequence to await feedback from the receiver. If the feedback indicates unsuccessful reception, transmit the sequence again.	Feedback from the receiver informs the transmitter whether or not the information data symbols have been received successfully. This is usually accomplished with error detection.
interleaving/deinterleaving	Interleaving rearranges the order of the symbols to spread out the symbols of each codeword.	Deinterleaving returns the symbols to their original pre-interleaving order so that they can be properly understood by the error correction and/or error detection decoders

52. With each of these techniques described above, it is well known that the operations performed at the transmitter portion of the transceiver at one end of the connection are distinct from the corresponding operations performed at the receiver portion of the transceiver at the other end of the connection. Encoding for error correction and/or error detection is performed only at the transmitter portion of the transceiver at the transmitting end of the connection and not at the receiver portion of the transceiver at the receiving end of the connection. Retaining and retransmitting is performed only at the transmitter and not in the receiver portion of the transceiver at the receiving end of the connection. Interleaving is performed only at the transmitter portion of the transceiver at the transmitting end of the connection and not in the receiver portion of the transceiver at the receiving end of the connection. Therefore, a person of ordinary skill in the art would find a claim element that instructs the receiver to receive a packet using interleaving, which is an operation performed only at the transmitter portion of the transceiver, to be meaningless and hence indefinite. Vice versa, a POSITA would likewise find a claim element that instructs the transmitter to transmit or retransmit a packet using forward error correction decoding and

deinterleaving, which are operations performed only at the receiver portion of the transceiver, to be meaningless and hence indefinite.

53. The specifications of the ’577 and ’809 Patents support my opinion. Specifically, each of the ’577 and ’809 Patents recites:

> Moreover, while some of the exemplary embodiments described herein are directed toward **a transmitter portion of a transceiver performing interleaving and/or coding on transmitted information**, it should be appreciated that **a corresponding deinterleaving and/or decoding is performed by a receiving portion of a transceiver**. Thus, while perhaps not specifically illustrated in every example, this disclosure is intended to include this corresponding functionality in both the same transceiver and/or another transceiver.

’577 Patent, 9:38–46; ’809 Patent, 9:66–10:07.

54. The above-quoted text of the ’577 and ’809 Patents’ specifications acknowledges that, with interleaving/deinterleaving, the interleaving function is performed at the transmitter portion of the transceiver at the transmitting end of the connection and the corresponding but distinct deinterleaving function is performed at the receiver portion of the transceiver at the receiving end of the connection. *See id*.

55. Consequently, and in view of the remarks above, a POSITA would have had no reasonable way to ascertain a meaning of the disputed claim terms set forth in claims 17 and 31 of the ’577 Patent and claim 24 of the ’809 Patent. Specifically, claims 17 and 31 of the ’577 Patent require that a receiver receive a packet using interleaving, which is an operation performed only at the transmitter portion of the transceiver. Likewise, claim 24 of the ’809 Patent requires that a transmitter retransmit a packet using deinterleaving, which is an operation performed only at the receiver portion of the transceiver. For at least these reasons, it is my opinion that a POSITA would not know or understand what is meant by each of these phrases.

56. For the same reasons explained above, it is my opinion that claims 37 and 53 of the ’577 Patent are indefinite. Much as a POSITA would have been unable to ascertain the meaning

of receiving a packet using interleaving because interleaving is a function performed at the transmitter portion of the transmitter, the POSITA would likewise have been unable to ascertain the meaning of receiving a message without using interleaving, as the implication is that the function of interleaving could be used. Because the claim language is directed to the function of interleaving at a receiver portion, and because interleaving is a function used only at the transmitter portion of the transmitter, the claim language is unclear. As a result, I agree with Defendants' position that each of the claim terms is indefinite.

4. "higher immunity to noise"

Claim(s)	Plaintiff's Position	Defendants' Position
'348 Patent, Claims 2 and 9 '809 Patent, Claims 1, 9, 16, 23	"higher SNR margin"	plain and ordinary meaning

57. I understand that the parties dispute the construction of the phrase "higher immunity to noise," which is in the above-referenced claims of the above-referenced patents. I also understand that the Plaintiff contends that the construction of this phrase is "higher SNR margin." Having considered the parties' positions, I agree with Defendants' interpretation. As I explain below, it is my opinion that a POSITA would have readily understood the term "higher immunity to noise" and would not have understood the term to be limited to only a "higher SNR margin."

58. The disputed term I address in this section is directed to messages communicated as positive or negative acknowledgments of a received packet. *See, e.g.*, '809 Patent,14:60–16:67. A POSITA attempting to discern a definition of the disputed term would have looked to the specification.

59. The '809 Patent's specification states explicitly, with regard to communication of

the positive and negative acknowledgement messages, that "it is important to make sure that these messages are as robust as possible and consume the least amount of data rate" because the channel used for their communication "**has a limited data rate and is not necessarily error-free**." *Id*. at 15:58–61 (emphasis added) (indicating that the positive and negative acknowledgments "can be transmitted over the same physical channel i.e., phone line, in the opposite direction as the received packets" and that "the channel has a limited data rate and is not necessarily error-free.").

60. To that end, the '809 Patent's specification provides "several ways these requirements can be addressed." *Id*. at 15:65. These "several ways" include "repeating transmission of each message a number of times," sending at least one repeated message in one or more discrete multi-tone ("DMT") symbols, sending a single message for multiple packets "using multiple packet count values," increasing a margin of signal-to-noise ratio of the DMT sub-carriers used for modulating the messages above a 6 decibels ("dB"), or any combination thereof. *See id*. at 15:55–16:67.

61. A POSITA reading the '809 Patent's specification, and in particular the above-cited portions, would have understood that each of the "ways" listed by the patent's inventive entity can be used alone or in combination with at least one of the other "ways." *See id*. at 15:65. Accordingly, a POSITA would have concluded that a message having a "higher immunity to noise" than another data unit can be achieved using one or more of "several ways" identified in the '809 Patent. In other words, the definition of this claim term is not limited to a single example disclosed in the specification.

62. I note that the '809 Patent's specification states the following:

> Alternatively, or in addition, the DMT sub-carriers that modulate these messages could operate with a much higher SNR margin e.g., 15 dB, as compared to the normal 6 dB margin of xDSL systems. This way, the messages would have a higher immunity to channel noise.

’809 Patent, 16:04–08.

63. Even in view of the above-cited portion of the ’809 Patent’s specification, a POSITA would have known that each of the “several ways” listed by the patent’s inventive entity, whether used alone or in combination with at least one of the other “ways,” can result in “messages [that] would have a higher immunity to channel noise.” *See id*. cols. 15:55–16:67. Reading the specification, it is clear to me that operating with a much higher SNR margin is merely one contemplated “way” of achieving a higher immunity to channel noise, and that there exists “several ways” of achieving the same goal. *See, e.g.*, *id.* at 15:55–65.

64. Consequently, it is my opinion that a POSITA would have concluded that the specification describes the term “higher immunity to noise” in an understandable manner that is not limited to “higher SNR margin,” as proposed by the Plaintiff. Accordingly, and based on my analysis above, it is my opinion that Defendants’ construction is correct.

I declare under penalty of perjury that the foregoing is true and correct. Executed this 14th day of March, 2022.

Richard D. Wesel

Richard D. Wesel, Ph.D.

Exhibit A

List of Materials Considered

- U.S. Patent No. 7,844,882
- U.S. Patent No. 8,276,048
- U.S. Patent No. 8,495,473
- U.S. Patent No. 9,547,608
- U.S. Patent No. 10,409,510
- U.S. Patent No. 8,595,577
- U.S. Patent No. 9,904,348
- U.S. Patent No. 10,833,809
- File History of U.S. Patent No. 7,844,882
- File History of U.S. Patent No. 8,276,048
- File History of U.S. Patent No. 8,495,473
- File History of U.S. Patent No. 9,547,608
- File History of U.S. Patent No. 10,409,510
- File History of U.S. Patent No. 8,595,577
- File History of U.S. Patent No. 9,904,348
- File History of U.S. Patent No. 10,833,809
- ITU-T G.993.2 VDSL2 Standard
- ITU-T G.993.1 VDSL1 Standard

Exhibit B

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EDUCATION

1991 – 1996, **Stanford University**, Stanford, CA
Ph.D. in Electrical Engineering
Trellis Code Design for Correlated Fading and Achievable Rates for Tomlinson-Harashima Precoding.

1984 – 1989, **Massachusetts Institute of Technology**, Cambridge, MA
S. M. and S. B. in Electrical Engineering
Thesis: *Adaptive Equalization for Modem Constellation Identification.*

EMPLOYMENT

1996 – present, **University of California, Los Angeles**, Los Angeles, CA

- **Associate Dean** of Academic and Student Affairs for the Henry Samueli School of Engineering and Applied Science since July 2007
- **Acting Director** HSSEAS MS Online Program, July 2007 – July 2008 (inaugural year of operation admitting students and offering classes)
- **Professor** of Electrical and Computer Engineering since July 2006
- **Associate Professor** of Electrical Engineering 2002-2006
- **Assistant Professor** of Electrical Engineering 1996-2001

1991 – 1996, **Stanford University**, Stanford, CA, Research Assistant and Teaching Assistant.

1986 – 1994, **AT&T Bell Laboratories**, Holmdel, NJ

- Member of Technical Staff summer 1994
- Member of Technical Staff 1989-1991
- Intern 1986-1989, two summer internships and a culminating 6-month internship.

AWARDS

- Fellow of the Institute of Electrical and Electronics Engineers (IEEE)
- Qualcomm Faculty Award
- Selected for the National Academy of Engineering Frontiers of Engineering Program
- TRW Excellence in Teaching Award (UCLA School of Engineering)
- Okawa Foundation Award for Excellence in Telecommunications Research
- National Science Foundation CAREER Award
- AT&T Foundation Ph.D. Fellow.
- Tau Beta Pi MIT chapter president 1987-1988, Eta Kappa Nu, Sigma Xi, National Merit Scholar.

ACADEMIC SERVICE

- **Associate Dean, Leading Office of Academic and Student Affairs**, including admissions and counseling for all engineering majors, July 2007 to present
- **Chair, Samueli COVID-19 Task Force** 2020-2021
- **Member, UCLA COVID-19 Academic Continuity Task Force** 2020-2021
- **Member, HSSEAS SEASnet review committee,** November 2018 to 2020
- **Chair, Summer Sessions Faculty Advisory Committee,** Sept. 2018 to present.
- **Member, Advisory Committee on Immigration Policy,** 2017 to 2021
- **HSSEAS Strategic Planning Committee for Education,** Jan. 2017-June 2018
- **Member, Center for the Integration of Research, Teaching, and Learning at UCLA, Steering Committee,** January 2017-present
- **Member, Classroom Advisory Committee,** November 2016 to present
- **Chair, UCLA Special Programs Task Force,** Feb. 2013- Sept. 2014
- **Member, UCLA Enrollment Planning Committee** October 2011-present
- **Member, UCLA Undergraduate Non-Resident Implementation Task Force** August 2010 – July 2011
- **Member of UCLA Undergraduate Council** July 2006- July 2008.
- **Member of the Committee on Undergraduate Admissions and Relations with Schools** July 2006- July 2008
- **Electrical Engineering Department Vice Chair for Undergraduate Affairs** July 2005 – July 2007. Successfully managed the 2006 ABET Accreditation visit for EE.
- **Member of the School of Engineering Faculty Executive Committee** 2003-2006.

- **Chair of the Electrical Engineering Department Courses and Curriculum Committee** 2003-2005.
- **Chair of the Communications Major Field** in the Electrical Engineering Department at the University of California, Los Angeles, 1999-2004.
- **Chair of the Cubicle Allocation Committee** for the Electrical Engineering Department at UCLA, managing the allocation of 150 student cubicles among approximately 20 professors who share this space, 1998-2005.
- **Chair of 2002 Annual Research Review** (annual departmental research symposium). Also Vice Chair of 2001 Annual Research Review.
- **Member of 2001 UCLA EE Annual Report Committee.**
- **Elected Member of the Legislative Assembly** of the UCLA Academic Senate, 1997-2001.
- **Chair for quarterly Seminar Series** in Signals and Systems. Established this seminar series in spring 1997. Recruit a professor each quarter to organize speakers for the series. Personally organized speakers for four of these quarters.
- **Local Exhibits Chair,** 1997 UCLA EE Research Symposium

GRADUATED PH.D. STUDENTS

1. Christina Fragouli, Ph.D. Sept. 2000, Dissertation: *Turbo Code Design for High Spectral Efficiency,* 2000-2001 UCLA EE Dept. Best Ph.D. Student 2001. **Professor at UCLA.**
2. Christos Komninakis, Ph.D. Dec. 2000, Dissertation: *Joint Channel Estimation and Decoding for Wireless Channels,* Senior Director of Technology, Qualcomm.
3. Xueting Liu, Ph.D. Dec. 2000, Dissertation: *Trellis Code Design for Periodic Erasures and Adaptive Coded, Modulation Schemes for Time-Varying Channels*, Apple Inc., CA
4. Wei Shi, Ph.D. Dec. 2000, Dissertation: *New Results in Wireless Communications*, Qualcomm
5. Tom Sun, Ph.D. Dec. 2002, Dissertation: *Error Protection Techniques for Source and Channel Coding*, Qualcomm, San Diego, CA
6. Chris Jones, Ph.D. Dec. 2003, Dissertation: *Constructions, applications, and implementations of low-density parity-check codes,* Co-founder Chilicon Power, Los Angeles, CA
7. Adina Matache, Ph. D. June 2004, Dissertation: *Coding Techniques for High Data Rates in Wireless Multiple-Input Multiple-Output Communications*, Aerospace Corp.
8. Cenk Kose,Ph.D. Dec. 2004, Dissertation*: Universal trellis codes and concatenated trellis-coded modulations for the compound linear vector Gaussian channel*
9. Aditya Ramamoorthy, June 2005, *Generalized ACE Codes and Theoretic Results in Network Coding*, **Associate Professor at Iowa State University**
10. Jun Shi, Ph.D. Sept. 2005, Dissertation: *Universal Channel Codes and Trellis State-Diagram Reduction,* Senior Principle Scientist at the Broadcom Corporation
11. Wen-Yen Weng, Ph.D. March 2007, Dissertation: *Universal Serially Concatenated Trellis Coded Modulations and Rate-Compatible High-Rate LDPC Codes*

12. Esteban Valles (Primary Advisor John Villasenor), Ph.D. March 2007, Dissertation: *Timing Recovery Using Soft Information Feedback and Efficiency of Array Codes,* Aerospace Corporation.
13. Andres Vila Casado, Ph.D. December 2007, Dissertation: *Improving LDPC Decoders: Informed Dynamic Message-Passing Scheduling and Multiple-Rate Code Design*
14. Herwin Chan (Primary Advisor Ingrid Verbauwhede), Ph.D. December 2007, Dissertation: *Accelerating Applications Through Cross-Layer Co-Design*
15. Miguel Griot, Ph.D. Sept. 2008, Dissertation: *Nonlinear Codes for Multiple Access to Binary Channels and Higher-Order Modulations over the AWGN Channel,* Qualcomm Corporation.
16. Bike Xie, Ph.D. June 2010, Dissertation: *Encoding for Degraded Broadcast Channels and Resource Allocation for content Distribution in Peer-To-Peer Networks,* Senior Staff Engineer-Manager at Marvell Corp
17. Thomas Courtade, Ph.D. June 2012, Dissertation: *Two Problems in Multiterminal Information Theory,* **Assistant Professor at UC Berkeley.**
18. Jiadong Wang, Ph.D. June 2012, Dissertation: *Absorbing Set Analysis of LDPC Codes and Read-Channel Quantization in Flash Memory*, Senior Engineer at Qualcomm.
19. Tsung-Yi Chen, Ph. D. September 2013, Dissertation: *Achieving Low-Latency Communication with Feedback: from Information Theory to Practical System Design,* SpiderCloud Wireless.
20. Adam Williamson, Ph. D June 2014, Dissertation: *Reliability-output Decoding and Low-latency Variable-Length Coding Schemes for Communication with Feedback,* Northrop Grumman Corp.
21. Kasra Vakilinia, Ph. D June 2014, Dissertation: *Coding Schemes to Approach Capacity in Short Blocklength with Feedback and LDPC Coding for Flash Memory,* Huawei Technologies.
22. Haobo Wang, Ph. D Decembner, 2018, Dissertation: *Optimizing Flash-Based Storage Systems*, SK Hynix.
23. Sudarsan V.S. Ranganathan, Ph. D December, 2018, Dissertation:, Advances in Protograph-Based LDPC Codes and a Rate Allocation Problem, Post Doctoral Scholar and Lecturer at the Massachusetts Institute of Technology.

RESEARCH FUNDING SOURCES 1996 - PRESENT

- Mercury Systems
- Qualcomm
- Zeta Corporation
- Physical Optics Corporation
- SA Photonics
- Micron Semiconductor
- National Science Foundation
- Western Digital Corporation
- INPHI Corporation
- Rockwell Collins
- The Broadcom Foundation

- Boeing
- Texas Instruments
- Conexant
- ST Microelectronics
- Northrop Grumman
- Skyworks
- Xetron Corporation
- Pacific Bell
- Honeywell

COURSES TAUGHT 1996 - PRESENT

- EE131A Probability
- EE132A Communications Systems
- EE231A Information Theory
- EE231E Channel Coding
- EE232A Stochastic Processes

PROFESSIONAL ACTIVITIES

- **Associate Editor,** IEEE Transactions on Information Theory, March 2020-present
- **Presenter** of half-day tutorial on Incremental Redundancy at Globecom 2019, December 2019.
- **Panel member** for National Science Foundation Proposal Review Panels.
- **Invited Speaker** half-day tutorial on Incremental Redundancy at the 2018 European School of Information Theory, Bertinoro, Italy, May 2018
- **Invited Speaker** at IEEE UCSD ITA Workshop, annually 2006-present
- **Reviewer** for various IEEE conferences and journals. Regularly reviewing submissions to Trans. on Information Theory, Trans. on Communications, Journal on Selected Areas of Communications, Communications Letters, Globecom, and International Conference on Communications, 1994-present.
- **Technical Program Committee Member,** numerous times for *Globecom*, *ICC, and ISIT.*
- **Organizer and lecturer** for UCLA Extension course on Error Control Coding (2000-2006). Received an award for being among the top 10% of UCLA extension lecturers.
- **Associate Editor***, IEEE Transactions on Communications* 1999-2005.

- **Technical Program Chair**, *Communication Theory Symposium at Globecom 2002.*
- **Organizer and Session Chair** for Special Session on Concatenated codes and iterative decoding at the *2001 Asilomar Conf. on Signals, Systems, and Computers.*
- **Session Organizer and Chair** for Communication Theory Symposium at the 2001 International Conference on Communications.
- **Organizer and Session Chair** for Special Session on Communication over Time Varying Channels at the *1999 Asilomar Conf. on Signals, Systems, and Computers.*
- **Invited speaker** 1998 and 2000 *IEEE Communication Theory Workshops.*
- **Invited speaker** Office of Naval Research, Naval Research Labs 1998 Turbo Codes Workshop.
- **Invited speaker** 1998 DARPA GloMo workshop on emerging technologies for hand-held wireless devices in military communication.
- **Instructor** for 1997 UCLA Extension course on wireless multimedia communications.
- **Invited speaker** at various universities and companies including Stanford, UC-Berkeley, UC-San Diego, Ohio State University, University of Arizona, Johns Hopkins University, Cornell, Telia Research, Lulea, Sweden, Lucent, Boeing, Xetron, Texas Instruments, Conexant, and Microsoft Research.

JOURNAL PUBLICATIONS (see all publications at http://www.seas.ucla.edu/csl)

1. H. Yang, E. Liang, M. Pan and R. D. Wesel, "CRC-Aided List Decoding of Convolutional Codes in the Short Blocklength Regime," in IEEE Transactions on Information Theory, **DOI**: 10.1109/TIT.2022.3150717.
2. L. Wang, C. Terrill, M. Stark, Z. Li, S. Chen, C. Hulse, C. Kuo, R. Wesel, G. Bauch, R. Pitchumani, "Reconstruction-Computation-Quantization (RCQ): A Paradigm for Low Bit Width LDPC Decoding," *IEEE Transactions on Communications*, 2022 Early Access Article, **DOI**: 10.1109/TCOMM.2022.3149913.
3. N. Farsad, W. Chuang, A. Goldsmith, C. Komninakis, M. Médard, C. Rose, L. Vandenberghe, E. E. Wesel, R. D. Wesel, "Capacities and Optimal Input Distributions for Particle-Intensity Channels," IEEE Transactions on Molecular, Biological and Multi-Scale Communications. December 2020, vol. 6, no. 3, pp. 220-232, **DOI**: 10.1109/TMBMC.2020.3035371.
4. T. Wiegart, F. D. Ros, M. P. Yankov, F. R. Steiner, S. Gaiarin, R. D. Wesel, "Probabilistically Shaped 4-PAM for Short-Reach IM/DD Links with a Peak Power Constraint", *Journal of Lightwave Technology*, October 2020 (Early Access) . **DOI:** 10.1109/JLT.2020.3029371.
5. M. Stark, L. Wang, G. Bauch, R. D. Wesel, "Decoding Rate-Compatible 5G-LDPC Codes with Coarse Quantization Using the Information Bottleneck Method", *IEEE Open Journal of the Communications Society*, May 2020, vol. 1, pp. 646-660, DOI: 10.1109/OJCOMS.2020.2994048.

6. H. Wang, S. V. S. Ranganathan, R. D. Wesel, "Variable-Length Coding with Shared Incremental Redundancy: Design Methods and Examples," *IEEE Transactions on Communications*, June 2019, vol. 67, no. 9, pp. 5981-5995. **DOI:** 10.1109/TCOMM.2019.2919626.
7. S. V. S. Ranganathan, D. Divsalar, R. D. Wesel, "Quasi-Cyclic Protograph-Based Raptor-Like LDPC Codes for Short Block-Lengths", *IEEE Transactions on Information Theory*, June 2019, vol. 65, no. 6, pp. 3758-3777, **DOI:** 10.1109/TIT.2019.2895322.
8. A. Heidarzadeh, J. Chamberland, R. D. Wesel, and P Parag, "A Systematic Approach to Incremental Redundancy with Application to Erasure Channels", *IEEE Transactions on Communications*, April 2019, vol. 67, no. 4, pp. 2620-2631, **DOI:** 10.1109/TCOMM.2018.2889254.
9. S. V. S. Ranganathan, "Allocating Redundancy Between Erasure Coding and Channel Coding when Fading Channel Diversity Grows with Codeword Length," *IEEE Transactions on Communications*, May 2017, vol. 65, no. 8, pp. 3226 - 3237. **DOI:** 10.1109/TCOMM.2017.2706728.
10. H. Wang, N. Wong, T.-Y. Chen, R. D. Wesel, "Using Dynamic Allocation of Write Voltage to Extend Flash Memory Lifetime", *IEEE Transactions on Communications*, November 2016, vol. 64, no. 11, pp. 4474-4486, **DOI:** 10.1109/TCOMM.2016.2607707.
11. K. Vakilinia, S. V. S. Ranganathan, D. Divsalar, and R. D. Wesel, "Optimizing Transmission Lengths for Limited Feedback with Non-Binary LDPC Examples" *IEEE Transactions on Communications*, June 2016, vol. 64, no. 6, pp. 2245-2257, **DOI:** 10.1109/TCOMM.2016.2538770.
12. C.-Y. Lou, B. Daneshrad, and R. D. Wesel, "Convolutional-Code-Specific CRC Code Design", *IEEE Transactions on Communications*, October 2015, vol. 63, no. 10, pp. 3459 – 3469, **DOI:** 10.1109/TCOMM.2015.2459058.
13. A. R. Williamson, T.-Y. Chen and R. D. Wesel, "Variable-length Convolutional Coding for Short Blocklengths with Decision Feedback", *IEEE Transactions on Communications*, July 2015, vol. 63, no. 7, pp. 2389 – 2403, **DOI:** 10.1109/TCOMM.2015.2429583.
14. T.-Y. Chen, K. Vakilinia, D. Divsalar, and R. D. Wesel, "Protograph-Based Raptor-Like LDPC Codes", *IEEE Transactions on Communications*, Vol. 63, No. 5, pp 1522-1530, May 2015, **DOI:** 10.1109/TCOMM.2015.2404842.
15. A. R. Williamson, M. Marshall, and R. D. Wesel, "Reliability-output Decoding of Tail-biting Convolutional Codes," *IEEE Transactions on Communications*, Vol. 62, No. 6, pp 1768-1778, June 2014, **DOI:** 10.1109/TCOMM.2014.2319264.
16. J. Wang, K. Vakilinia, T.-Y. Chen, T. Courtade, G. Dong, T. Zhang, H. Shankar, and R. D. Wesel, "Enhanced Precision Through Multiple Reads for LDPC Decoding in Flash Memories" *IEEE Journal on Selected Areas in Communications*, Vol. 32, No. 5, pp 880-891, May 2014, **DOI:** 10.1109/JSAC.2014.140508.
17. T.A. Courtade and R. D. Wesel, "Coded Cooperative Data Exchange in Multihop Networks," *IEEE Transactions on Information Theory*, Vol. 60, No. 2, pp. 1136-1158, February 2014, **DOI:** 10.1109/TIT.2013.2290993.
18. J. Wang, L. Dolecek and R. Wesel, "The Cycle Consistency Matrix Approach to LDPC Absorbing Sets in Separable Circulant-Based Codes," *IEEE Transactions on Information Theory*, Vol. 59, No. 4, pp 2293 - 2314, April 2013, **DOI:** 10.1109/TIT.2012.2235122.

19. B. Xie, T. A. Courtade, and R. D. Wesel, "Optimal Encoding Schemes for Several Classes of Discrete Degraded Broadcast Channels," *IEEE Transactions on Information Theory*, Vol. 59, No. 3, pp. 1360-1378, March 2013, **DOI:** 10.1109/TIT.2012.2237095.
20. M. Griot, A. I. Vila Casado, W.-Y. Weng, H. Chan and R. D. Wesel," Nonlinear Trellis Codes for Binary-Input Binary-Output Multiple Access Channels With Single-User Decoding," *IEEE Transactions on Communications*, Vol. 60, No. 2, Feb. 2012, **DOI:** 10.1109/TCOMM.2012.010512.070116.
21. T. A. Courtade and R. D. Wesel," Optimal Allocation of Redundancy Between Packet-Level Erasure Coding and Physical-Layer Channel Coding in Fading Channels," *IEEE Transactions on Communications*, Vol. 59, No. 8, pp. 2101-2109, August 2011, **DOI:** 10.1109/TCOMM.2011.062311.090277.
22. A. I. Vila Casado, M. Griot, and R. D. Wesel, "LDPC Decoders with Informed Dynamic Scheduling ," *IEEE Transactions on Communications*, Vol. 58, No. 12, pp 3470-3479, December 2010, **DOI:** 10.1109/TCOMM.2010.101910.070303.
23. A. I. Vila Casado, W.-Y. Weng, S. Valle, and R. D. Wesel, " Multiple-Rate Low-Density Parity-Check Codes with Constant Blocklength ," *IEEE Transactions on Communications*, Vol. 57, No. 1, pp 75-83, January 2009, **DOI:** 10.1109/TCOMM.2009.0901.060256.
24. H. Chan, A. I. Vila Casado, J. Basak, M. Griot, W.-Y. Weng, R. D. Wesel, B. Jalali, E. Yablonovitch, I. Verbauwhede, " Demonstration of Uncoordinated Multiple Access in Optical Communications ," *IEEE Transactions on Circuits and Systems-I: Regular Papers*, Vol. 55, No. 10, pp 3259-3269, November 2008, **DOI:** 10.1109/TCSI.2008.925365.
25. W.-Y. Weng, C. Kose, B. Xie and R. D. Wesel, " Universal Serially Concatenated Trellis Coded Modulation for Space-Time Channels *,"* *IEEE Transactions on Communications*, Vol. 56, No. 10, pp 1636-1646, October 2008, **DOI:** 10.1109/TCOMM.2008.060530.
26. B. Xie, M. Griot, A. I. Vila Casado, and R. D. Wesel, " Optimal Transmission Strategy and Explicit Capacity Region for Broadcast Z Channels ," *IEEE Transactions on Information Theory*, Vol. 53, No. 9, pp 4296-4304, September 2008, **DOI:** 10.1109/TIT.2008.928298.
27. J. Shi and R. D. Wesel, " A Study on Universal Codes with Finite Block Lengths," *IEEE Transactions on Information Theory*, Vol. 54, No. 9, pp 3066-3074, September 2007, **DOI:** 10.1109/TIT.2007.903156.
28. M. Griot, W.-Y. Weng and R. D. Wesel, " A Tighter Bhattacharyya Bound for Decoding Error Probability," *IEEE Communications Letters*, Vol.11, No. 4, pp 346-347, April 2007, **DOI:** 10.1109/LCOM.2007.348296.
29. C. R. Jones, T. Tian, J. Villasenor and R. D. Wesel, " The Universal Operation of LDPC Codes Over Scalar Fading Channels," *IEEE Transactions on Communications*, Vol. 55, no. 1, pp 122-132, Jan. 2007, **DOI:** 10.1109/TCOMM.2006.885081.
30. Kose C. and Wesel R. D., " Universal Space-Time Codes from Demultiplexed Trellis Codes," *IEEE Trans. on Communications*. Vol.54. No 7. July 2006, **DOI:** 10.1109/TCOMM.2006.877967.
31. F. Peng, W. Ryan. and R. D. Wesel," Surrogate-Channel Design of Universal LDPC Codes," *IEEE Comm. Letters*, Jun. 2006, vol. 10, no. 6, pp 480-482, **DOI:** 10.1109/LCOMM.2006.1638622

32. A. Ramamoorthy, J. Shi and R. D. Wesel, " On the Capacity of Network Coding for Random Networks," *IEEE Transactions on Information Theory*, Aug. 2005, Vol. 51, no. 8, pp 2878-2885, **DOI:** 10.1109/TIT.2005.851725.
33. Wesel R. D., "Reduced-State Representations for Trellis Codes Using Constellation Symmetry," *IEEE Transactions on Communications*, Aug. 2004, vol. 52, no. 8 pp 1302-1310, **DOI:** 10.1109/TCOMM.2004.833023.
34. Tian T., Jones C., Villasenor J. D. and Wesel R. D., "Selective Avoidance of Cycles in Irregular LDPC Code Construction," *IEEE Transactions on Communications*, Aug. 2004, vol. 52(8), pp 1242-1247, **DOI:** 10.1109/TCOMM.2004.833048.
35. Sun T. W., Wesel R. D., Shane M. R. and Jarett K., "Superposition Turbo-TCM for Multi-Rate Broadcast," *IEEE Transactions on Communications*, Mar. 2004, vol. 52(3), pp 368-371, **DOI:** 10.1109/TCOMM.2004.823646.
36. Shi J. and Wesel R. D., "Efficient Computation of Trellis Code Generating Functions," *IEEE Transactions on Communications*, Feb. 2004, vol. 52(2), pp 219-227, **DOI:** 10.1109/TCOMM.2003.822702.
37. Matache A. and Wesel R. D., "Universal Trellis Codes for Diagonally Layered Space-Time Systems," *IEEE Transactions on Signal Processing*, Nov. 2003, vol. 51(11) pp 2773-2783, Special Issue on "MIMO Wireless", **DOI:** 10.1109/TSP.2003.818159.
38. Kose C. and Wesel R. D., "Universal Space-Time Trellis Codes," *IEEE Trans. on Info. Theory*, Oct. 2003, vol. 40(10) pp 2717-2727 Special Issue on "Space-Time Transmission, Reception, Coding and Signal Design," **DOI:** 10.1109/TIT.2003.817459.
39. Q. Zhang, P. K. Varshney, and R. D. Wesel, "Optimal Bi-level quantization of I.I.D Sensor Observations for Binary Hypothesis Testing," *IEEE Transactions on Information Theory*, July 2002, 48(7) pp. 2105-2110, **DOI:** 10.1109/TIT.2002.1013153.
40. C. Komninakis, C. Fragouli, A. H. Sayed, and R. D. Wesel, "Multi-Input, Multi-output Fading Channel Tracking and Equalization Using Kalman Estimation," *IEEE Transactions on Signal Processing*, May 2002, vol. 50(5), pp. 1065-1076, **DOI:** 10.1109/78.995063.
41. A. Bernard, X. Liu, R. D. Wesel, and A. Alwan, "Multi-rate Transmission of Speech Using Rate-Compatible Trellis Codes and Embedded Source Codes," *IEEE Transactions on Communications*, February 2002, vol. 50(2) pp. 309-320, **DOI:** 10.1109/26.983326.
42. P. Ormeci, D. L. Goeckel, X. Liu, and R. D. Wesel, "Adaptive Bit-Interleaved Coded Modulation for Time-Varying Channels Using Outdated Fading Estimates" *IEEE Transactions on Communications*, Sept. 2001, 49(9), pp. 1572-1581, **DOI:** 10.1109/26.950344.
43. R. D. Wesel, X. Liu, J. M. Cioffi, and C. Komninakis, "Constellation Labeling for Linear Encoders," *IEEE Transactions on Information Theory*, Sept. 2001, 47(6), pp. 2417-2431, **DOI:** 10.1109/18.945255.
44. C. Komninakis and R..D. Wesel, "Joint Iterative Channel Estimation and Decoding in Flat Correlated Rayleigh Fading," *IEEE Journal on Selected Areas in Communications*, Sept. 2001, 19(9), pp. 1706-17, **DOI:** 10.1109/49.947035.
45. C. Fragouli and R. D. Wesel, "Turbo encoder design for symbol interleaved parallel concatenated trellis coded modulation," *IEEE Transactions on Communications*, 49(3), Mar. 2001, pp. 425-435, **DOI:** 10.1109/26.911450.
46. W. Shi, T. W. Sun, and R. D. Wesel, "Quasi-convexity and Optimal Binary Fusion for Distributed Detection with Identical Sensors in Generalized Gaussian Noise," *IEEE Transactions on Information Theory*, Jan. 2001, 47(1), pp. 446-450, **DOI:** 10.1109/18.904560.

47. R. D. Wesel, X. Liu, and W. Shi, "Trellis Codes for Periodic Erasures," *IEEE Transactions on Communications,* June 2000, 48(6), pp. 938-947, **DOI:** 10.1109/26.848553.
48. R. D. Wesel and J. M. Cioffi, "Trellis Codes for Periodic Interleavers," *IEEE Communications Letters*, April 1999, 3(4), pp. 103-105, **DOI:** 10.1109/4234.757202.
49. R. D. Wesel, and J. Cioffi, "Achievable Rates for Tomlinson-Harashima Precoding," *IEEE Transactions on Information Theory*, Mar. 1998, 44(2), pp. 824-831, **DOI:** 10.1109/18.661530.

CONFERENCE PUBLICATIONS

1. J. Nguyen, L. Wang, C. Hulse, S. Dani, A. Antonini, T. Chauvin, D. Dariush, R. Wesel, "Neural Normalized Min-Sum Message-Passing vs. Viterbi Decoding for the CCSDS Line Product Code", ICC 2022, Seoul, South Korea, May 16–20, 2022.
2. L. Wang, D. Song, F. Areces, and R. D. Wesel. "Achieving Short-Blocklength RCU bound via CRC List Decoding of TCM with Probabilistic Shaping", ICC 2022, Seoul, South Korea, May 16–20, 2022.
3. W. Sui, H. Yang, B. Towell, A. Asmani, R. Wesel, "High-Rate Convolutional Codes with CRC-Aided List Decoding for Short Blocklengths", ICC 2022, Seoul, South Korea, May 16–20, 2022.
4. J. King, A. Kwon, H. Yang, W. Ryan, R. Wesel, "CRC-Aided List Decoding of Convolutional and Polar Codes for Short Messages in 5G", ICC 2022, Seoul, South Korea, May 16-20, 2022.
5. C. Terrill, L. Wang, S. Chen, C. Hulse, C. Kuo, R. Wesel, D. Divsalar, "FPGA Implementations of Layered MinSum LDPC Decoders Using RCQ Message Passing", 2021 IEEE Global Communications Conference (GLOBECOM), Madrid, Spain, Dec. 7-11, 2021.
6. L. Wang, S. Chen, J. Nguyen, D. Dariush, R. Wesel, "Neural-Network-Optimized Degree-Specific Weights for LDPC MinSum Decoding", 2021 International Symposium on Topics in Coding (ISTC), Montréal, Canada, Aug. 30-Sept. 3, 2021.
7. A. Antonini, R. Gimelshein, R. D. Wesel, "Causal (Progressive) Encoding over Binary Symmetric Channels with Noiseless Feedback", 2021 IEEE International Symposium on Information Theory (ISIT), Melbourne, Victoria, Australia, July 12-20, 2021.
8. D. Xiao, L. Wang, D. Song, R. D. Wesel, "Finite-Support Capacity-Approaching Distributions for AWGN Channels," 2020 IEEE Information Theory Workshop, Online, April 11-15 2021.
9. A. Arafa, R. D. Wesel, "Timely Transmission Using Optimized Variable Length Coding," 2021 IEEE INFOCOM Age of Information Workshop, Online, May 10, 2021.
10. L. Wang, M. Stark, R. D. Wesel, G. Bauch, "A Reconstruction-Computation-Quantization (RCQ) Approach to Node Operations in LDPC Decoding," 2020 IEEE Global Communications Conference, Taipei, Taiwan, Dec. 7-11, 2020.
11. J. Nguyen, E. Liang, L. Wang, T. Drullinger, T. Chauvin, R. D. Wesel, "Comparison of Integrated and Independent RF/FSOTransceivers on a Fading Optical Channel," 2020 Asilomar Conference on Signals, Systems, and Computers, Pacific Grove, CA, USA, Nov. 1-5, 2020.

12. Hengjie Yang, Linfang Wang, Vincent Lau, Richard D. Wesel, "An Efficient Algorithm for Designing Optimal CRCs for Tail-Biting Convolutional Codes", 2020 IEEE International Symposium on Information Theory, June 21-26, 2020, Los Angeles, CA.
13. Amaael Antonini, Hengjie Yang, Richard D. Wesel, "Low Complexity Algorithms for Transmission of Short Blocks over the BSC with Full Feedback," 2020 IEEE International Symposium on Information Theory, June 21-26, 2020, Los Angeles, CA.
14. Hengjie Yang, Richard D. Wesel, "Finite-Blocklength Performance of Sequential Transmission over BSC with Noiseless Feedback", 2020 IEEE International Symposium on Information Theory, June 21-26, 2020, Los Angeles, CA.
15. Maximilian Stark, Gerhard Bauch, Linfang Wang, Richard D. Wesel, "Information Bottleneck Decoding of Rate-Compatible 5G-LDPC Codes", 2020 IEEE Int. Conf. Commun., Virtual Conference, June 7-11, 2020.
16. H. Yang, E. Liang, H. Yao, A. Vardy, D. Divsalar, and R. D. Wesel, "A List-Decoding Approach to Low-Complexity Soft Maximum-Likelihood Decoding of Cyclic Codes," 2019 IEEE Global Communications Conference, Dec. 9-13, 2019, Waikoloa, HI, USA.
17. E. Liang, H. Yang, H. Yao, D. Divsalar, and R. D. Wesel, "List-Decoded Tail-Biting Convolutional Codes with Distance-Spectrum Optimal CRCs for 5G," 2019 IEEE Global Communications Conference, Dec. 9-13, 2019, Waikoloa, HI, USA.
18. N. Wong, H. Wang, E. Liang, S. V. S. Ranganathan, and R. D. Wesel, "Decoding Flash Memory with Progressive Reads and Independent vs. Joint Encoding of Bits in a Cell," 2019 IEEE Global Communications Conference, Dec. 9-13, 2019, Waikoloa, HI, USA.
19. H. Yang and R. D. Wesel, "On the Most Informative Boolean Functions of the Very Noisy Channel," 2019 IEEE International Symposium on Information Theory, July 7-12, 2019, Paris, France.
20. H. Yang and R. D. Wesel, "Serial List Viterbi Decoding with CRC: Managing Errors, Erasures, and Complexity," 2018 IEEE Global Communications Conference, Dec. 9-13, 2018, Abu Dhabi, UAE.
21. H. Wang and R. D. Wesel, "Channel Code Analysis and Design using Multiple Variable-Length Codes in Parallel without Feedback," 2018 IEEE Global Communications Conference, Dec. 9-13, 2018, Abu Dhabi, UAE.
22. R. D. Wesel, N. Wong, A. Baldauf, A. Belhouchat, A. Heidarzadeh, and J.-F. Chamberland, "Transmission Lengths that Maximize Throughput of Variable-Length Coding & ACK/NACK Feedback," 2018 IEEE Global Communications Conference, Dec. 9-13, 2018, Abu Dhabi, UAE.
23. A. Baldauf, A. Belhouchat, N. Wong, R. D.Wesel, "Efficient Computation of Convolutional Decoder Reliability Without a CRC," Asilomar Conference on Signals, Systems and Computers, Pacific Grove, CA, October 28-31, 2018.
24. S. V. S. Ranganathan, R. D. Wesel and D. Divsalar, "Linear Rate-Compatible Codes with Degree-1 Extending Variable Nodes Under Iterative Decoding," 2018 IEEE International Symposium on Information Theory (ISIT), Vail, CO, USA, 2018, pp. 1166-1170.
25. A. Heidarzadeh, J. Chamberland, P. Parag and R. D. Wesel, "A Systematic Approach to Incremental Redundancy over Erasure Channels," 2018 IEEE International Symposium on Information Theory (ISIT), Vail, CO, USA, 2018, pp. 1176-1180.

26. R. D. Wesel, E. E. Wesel, L. Vandenberghe, C. Komninakis, and M. Medard, "Efficient Binomial Channel Capacity Computation with an Application to Molecular Communication," IEEE 2018 Inf. Theory and Applications (ITA) Workshop. La Jolla, CA. February 11 - February 16, 2018.
27. S. V. S. Ranganathan, D. Divsalar, and R. D. Wesel, "Design of Improved Quasi-Cyclic Protograph-Based Raptor-Like LDPC Codes for Short Block-Lengths," IEEE Int. Symp. Inf. Theory (ISIT). June 2017.
28. H. Wang, S. V. S. Ranganathan, and R. D. Wesel, "Approaching Capacity Using Incremental Redundancy without Feedback," IEEE Int. Symp. Inf. Theory (ISIT).). June 2017.
29. H. Wang, N. Wong, A. M. Baldauf, C. K. Bachelor, S. V. S. Ranganathan, D. Divsalar, and R. D. Wesel, "An Information Density Approach to Analyzing and Optimizing Incremental Redundancy with Feedback," IEEE Int. Symp. Inf. Theory (ISIT).). June 2017.
30. N. Wong, K. Vakilinia, H. Wang, S. V. S. Ranganathan, and R. D. Wesel, "Sequential Differential Optimization of Incremental Redundancy Transmission Lengths: An Example with Tail-Biting Convolutional Codes," IEEE 2016 Inf. Theory and Applications (ITA) Workshop. La Jolla, CA. February 12 - February 17, 2017.
31. S. V. S. Ranganathan, K. Vakilinia, D. Divsalar, and R. D. Wesel, "Universal Rate-Compatible LDPC Code Families for Any Increment Ordering". 9th Int. Symp. Turbo Codes & Iterative Information Processing (ISTC), Brest, France, September 5 - September 9, 2016.
32. R. D. Wesel, K. Vakilinia, S. V. S. Ranganathan, T. Mu, and D. Divsalar, "Resource-Aware Incremental Redundancy in Feedback and Broadcast," In Proceedings of the 2016 International Zurich Seminar on Communications, March 2-4, 2016, pp 63-67.
33. S. V. S. Ranganathan, K. Vakilinia, L. Dolecek, D. Divsalar, and R. D. Wesel, "Some Results on Spatially Coupled Protograph LDPC Codes". IEEE 2016 Inf. Theory and Applications (ITA) Workshop. La Jolla, CA. February 12 - 17, 2016.
34. H. Wang, N. Wong, and R. D. Wesel, "Dynamic Voltage Allocation with Quantized Voltage Levels and Simplified Channel Modeling," 49th Asilomar Conference on Signals, Systems and Computers, Pacific Grove, CA November 8-11, 2015.
35. S. V. S. Ranganathan, D. Divsalar, and R. D. Wesel, "On the Girth of (3,L) Quasi-Cyclic LDPC Codes Based on Complete Photographs". IEEE Int. Symp. Inf. Theory (ISIT). Wanchai, Hong Kong. June 14 - 19, 2015. DOI: 10.1109/ISIT.2015.7282491
36. K. Vakilinia, D. Divsalar, and R. D. Wesel, "RCA Analysis of the Polar Codes and the use of Feedback to aid Polarization at Short Blocklengths", IEEE Int Symp. INf. Theory (ISIT), Wanchai, Hong Kong, June 14-19, 2015.
37. H. Wang, T.-Y. Chen, and R. D. Wesel, "Histogram-Based Flash Channel Estimation", IEEE Int. Conf. Commun., London, UK, June 8-12, 2015.
38. C.-Y. Lou, B. Daneshrad, and R. D. Wesel, "Optimizing Pilot Length for a Go/No-Go Decision in Two-State Block Fading Channels with Feedback", IEEE Int. Conf. Commun., London, UK, June 8-12, 2015.
39. K. Vakilinia, D. Divsalar, and R. D. Wesel, "Protograph-Based Raptor-Like LDPC Codes for the Binary Erasure Channel". IEEE 2015 Inf. Theory and Applications (ITA) Workshop. La Jolla, CA. February 1 - February 6, 2015.
40. K. Vakilinia, A. R. Williamson, S. V. S. Ranganathan, D. Divsalar, R. D. Wesel, "Feedback Systems using Non-Binary LDPC Codes with a Limited Number of Transmissions". IEEE Information Theory Workshop (ITW). Hobart, Tasmania, Australia. Nov. 2 – Nov. 5, 2014.

41. K. Vakilinia, D. Divsalar, and R. D. Wesel, "Optimized Degree Distributions for Binary and Non-Binary LDPC Codes in Flash Memory". IEEE Int. Symp. Inf. Theory and Applicat. (ISITA), Melbourne, Australia, October 26 – 29, 2014.

42. K. Vakilinia, T.-Y. Chen, S. V. S. Ranganathan, A. R. Williamson, D. Divsalar, and R. D. Wesel, "Short-Blocklength Non-Binary LDPC Codes with Feedback-Dependent Incremental Transmissions". IEEE Int. Symp. Inf. Theory (ISIT), Honolulu, Hawaii, USA, June 29 - July 4, 2014.

43. S. V. S. Ranganathan, D. Divsalar, K. Vakilinia, and R. D. Wesel, "Design of High-Rate Irregular Non-binary LDPC Codes Using Algorithmic Stopping-Set Cancellation". IEEE Int. Symp. Inf. Theory (ISIT), Honolulu, Hawaii, USA, June 29 - July 4, 2014.

44. T.-Y. Chen, A. R. Williamson, and R. D. Wesel, "Asymptotic Expansion and Error Exponent of Two-Phase Variable-Length Coding with Feedback for Discrete Memoryless Channels". IEEE Int. Symp. Inf. Theory (ISIT), Honolulu, Hawaii, USA, June 29 - July 4, 2014.

45. T.-Y. Chen, D. Divsalar, and R. D. Wesel, "Finite-blocklength analysis of rate-compatible codes". IEEE Int. Symp. Inf. Theory (ISIT), Honolulu, Hawaii, USA, June 29 - July 4, 2014.

46. T.-Y. Chen, A. R. Williamson, and R. D. Wesel, "Increasing Flash Memory Lifetime by Dynamic Voltage Allocation for Constant Mutual Information". IEEE Inf. Theory and Applications (ITA) Workshop, San Diego, CA, USA, February 9 - 14, 2014.

47. T.-Y. Chen, A. R. Williamson, and R. D. Wesel, "Variable-length Coding with Feedback: Finite-length Codewords and Periodic Decoding". IEEE Int. Symp. Inf. Theory (ISIT), Istanbul, Turkey, July 7 - 12, 2013.

48. A. R. Williamson, T.-Y. Chen, and R. D. Wesel, "Reliability-based Error Detection for Feedback Communication with Low Latency". IEEE Int. Symp. Inf. Theory (ISIT), Istanbul, Turkey, July 7 - 12, 2013.

49. A. R. Williamson, T.-Y. Chen, and R. D. Wesel, "Firing the Genie: Two-Phase Short-blocklength Convolutional Coding with Feedback". IEEE Inf. Theory and Applications (ITA) Workshop, San Diego, CA, USA, February 12-16, 2013.

50. T.-Y. Chen, D. Divsalar, and R. D. Wesel, "Chernoff Bounds for Analysis of Rate- Compatible Sphere-Packing with Numerous Transmissions". IEEE Inf. Theory Workshop (ITW), Lausanne, Switzerland September 3 - 7, 2012.

51. A. R. Williamson, T.-Y. Chen, and R. D. Wesel, “A Rate-Compatible Sphere-Packing Analysis of Feedback Coding with Limited Retransmissions”. IEEE Int. Symp. Inf. Theory (ISIT), Cambridge, MA, USA, July 1-6, 2012.

52. A. Marinoni, P. Savazzi and R. D. Wesel, "On q-ary LDPC Code Design for a Low Error Floor". Globecom 2011, Houston, Texas, USA, December 2011.

53. T.-Y. Chen, D. Divsalar, J. Wang and R. D. Wesel, "Protograph-Based Raptor-Like LDPC Codes for Rate Compatibility with Short Blocklengths". Globecom 2011, Houston, Texas, USA, December 2011.

54. J. Wang, H. Shankar and R. D. Wesel, "Soft Information for LDPC Decoding in Flash:Mutual-Information Optimized Quantization". Globecom 2011, Houston, Texas, USA, December 2011.

55. T. A. Courtade, J. Wang, and R. D. Wesel, "Superposition Coding to Support Multiple Streams, Priorities, and Channel Capacities in the Context of GMSK", to appear in MILCOM, Nov 2011.

56. T. A. Courtade and R. D. Wesel, "Weighted Universal Recovery, Practical Secrecy, and an Efficient Algorithm for Solving Both". Forty-Ninth Annual Allerton Conference on Communication, Control, and Computing, 2011.

57. B. Xie, M. van der Schaar, T. A. Courtade and R. D. Wesel, "Minimizing Weighted Sum Finish Time for One-To-Many File Transfer in Peer-To-Peer Networks". Forty-Ninth Annual Allerton Conference on Communication, Control, and Computing, 2011.
58. T. A. Courtade and R. D. Wesel, "Multiterminal Source Coding with an Entropy-Based Distortion Measure". ISIT 2011, Saint-Petersburg, Russia, August 2011.
59. J. Wang, L. Dolecek, Z. Zhang and R. D. Wesel, "Absorbing Set Spectrum Approach for Practical Code Design". ISIT 2011, Saint-Petersburg, Russia, August 2011.
60. J. Wang, L. Dolecek and R. D. Wesel, "Controlling LDPC Absorbing Sets via the Null Space of the Cycle Consistency Matrix". ICC 2011, Kyoto, Japan, June 2011.
61. T.-Y Chen, N. Seshadri and R. D. Wesel, "A Sphere-Packing Analysis of Incremental Redundancy with Feedback". ICC 2011, Kyoto, Japan, June 2011.
62. J. Wang, L. Dolecek and R. D. Wesel, "LDPC Absorbing Sets, the Null Space of the Cycle Consistency Matrix, and Tanner's Constructions". ITA 2011, San Diego, CA, USA, Feb. 2011.
63. T.-Y Chen, N. Seshadri and R. D. Wesel, "Incremental Redundancy: A Comparison of a Sphere-Packing Analysis and Convolutional Codes". ITA 2011, San Diego, CA, USA, Feb 2011.
64. T. A. Courtade and R. D. Wesel, "Efficient Universal Recovery in Broadcast Networks". Forty-Eighth Annual Allerton Conference on Communication, Control, and Computing: Monticello, IL, Sept. 29-Oct. 1, 2010.
65. E. L. Valles, R. D. Wesel, J. D. Villasenor, C. R. Jones and M. Simon, "Pilotless Carrier Phase-Synchronization via LDPC Code Feedback". MILCOM 2010: San Jose, CA, Oct. 31 - Nov 3, 2011.
66. T. A. Courtade, B. Xie, and R. D. Wesel, "Optimal Exchange of Packets for Universal Recovery in Broadcast Networks". MILCOM 2010: San Jose, CA, Oct. 31 - Nov 3, 2010.
67. A. Marinoni, P. Savazzi and R. D. Wesel, "Protograph-based q-ary LDPC Codes for Higher-Order Modulation". ISTC 2010: Brest, France, Sept 6-10, 2010.
68. T. A. Courtade and R. D. Wesel, "A Deterministic Approach to Rate-Compatible Fountain Communication". ITA 2010: La Jolla, CA, Jan. 31 - Feb. 5, 2010.
69. B. Xie and R. D. Wesel, "Optimal Natural Encoding Scheme for Discrete Multiplicative Degraded Broadcast Channels". ISIT 2009: Seoul, Korea, June 28-July 3, 2009.
70. A. Marinoni, T. A. Courtade and R. D. Wesel, "Spectrally Efficient LDPC Coded Modulations". GTTI 2009: sessione Trasmissione, Parma, Italy, June 23-25, 2009. ***Winner of the Francesco Carassa award for the best paper from a young scientist in the sessione Trasmissione.***
71. T. A. Courtade and R. D. Wesel, "A Cross-Layer Perspective on Rateless Coding for Wireless Channels". ICC 2009, Dresden, Germany, June 14-18, 2009.
72. B. Xie and R. D. Wesel, Optimal Independent-Encoding Schemes for Input-Symmetric Degraded Broadcast Channels". ITA 2008, San Diego, USA, Jan. 27 - Feb. 1, 2008.
73. B. Xie and R. D. Wesel, "A Mutual Information Invariance Approach to Symmetry in Discrete Memoryless Channels". ITA 2008, San Diego, USA, Jan. 27 - Feb. 1, 2008.
74. Miguel Griot, A. I. Vila Casado, and R. D. Wesel, "Nonlinear Turbo Codes for Higher-Order Modulations". ICC 2008, Beijing, China, May 2008.
75. Y.M. Chang, A. I. Vila Casado, M.F. Chang, and R. D. Wesel, "Lower-Complexity Layered Belief Propagation Decoding of LDPC Codes". ICC 2008, Beijing, China, May 2008.

76. M. Griot, A. I. Vila Casado, and R. D. Wesel, "On the Design of Arbitrarily Low-Rate Turbo-Codes". Globecom 2007, Washington, D.C., November 2007.
77. A. I. Vila Casado, M. Griot and R. D. Wesel, "Improving LDPC Decoders via Informed Dynamic Scheduling". ITW 2007, Lake Tahoe, CA, USA, September 2007, pp 208-213.
78. B. Xie, M. Griot, A. I. Vila Casado and R. D. Wesel, "Optimal Transmission Strategy and Capacity Region for Broadcast Z Channels". ITW 2007, Lake Tahoe, CA, USA, September 2007, pp 390-395.
79. A. I. Vila Casado, M. Griot and R. D. Wesel, "Informed Dynamic Scheduling for Belief-Propagation Decoding of LDPC Codes". ICC 2007, Glasgow, Scotland, July 2007, pp 932-937.
80. H. Chan, M. Griot, A. Vila Casado, R. Wesel, I. Verbauwhede "High Speed Channel Coding Architectures for the Uncoordinated OR Channel". IEEE 17th INTERNATIONAL CONFERENCE ON Application-specific Systems, Architectures and Processors (ASAP), Steamboat Springs, Colorado, September 2006.
81. M.Griot, A. I. Vila Casado and R. D. Wesel "Non-linear Turbo Codes for Interleaver-Division Multiple Access on the OR Channel". Globecom 2006, 27 Nov. - 1 Dec., San Francisco, USA.
82. W.-Y. Weng, B. Xie and R. D. Wesel "Universal Space-Time Serially Concatenated Trellis Coded Modulations". Globecom 2006, 27 Nov. - 1 Dec., San Francisco, USA.
83. A. I. Vila Casado, S. Valle, W.-Y. Weng, and R. D. Wesel "Constant-Blocklength Multiple-Rate LDPC Codes for Analog-Decoding Implementations". Proceedings Analog Decoding Workshop, June 2006.
84. E.Valles, C. Jones, R. Wesel and J. Villasenor "Carrier and Timing Synchronization of BPSK via LDPC Code Feedback". IEEE 40th Asilomar Conference on Signals, Systems and Computers. Pacific Grove,CA. Nov.2006.
85. M. Simon, E. Valles, C. Jones, R. Wesel and J. Villasenor "Information-Reduced Carrier Synchronization of BPSK and QPSK Using Soft Decision Feedback" The IEEE 44th Annual Allerton Conference on Communication, Control and Computing. Urbana,IL Sep. 2006.
86. M. Griot, A. I. Vila Casado, W.-Y. Weng, H. Chan, J. Basak, E. Yablonovitch, I. Verbauwhede, B. Jalali, and R. D. Wesel "Trellis Codes with Low Ones Density for the OR Multiple Access Channel" , IEEE ISIT, Seatte, USA, July 2006.
87. M.Griot, A. I. Vila Casado, W.-Y. Weng, H. Chan, J. Basak, E. Yablonovitch, I.Verbauwhede, B. Jalali, and R. D. Wesel "Interleaver-Division Multiple Access on the OR Channel" Information Theory and Applications workshop. San Diego, 2006.
88. Yang Han, William E. Ryan and Wesel R. D. "Dual-Mode Decoding of Product Codes with Application to Tape Storage" , IEEE GlobeCom 2005. St Louis, MO., vol. 3, 28 Nov.-2 Dec. 2005, pp 1255-1260.
89. Valles E., Vila Casado A. I., Blaum M., Villasenor J and Wesel R. D., "Hamming Codes Are Rate-Efficient ArrayCodes" , IEEE GlobeCom 2005. St Louis, MO., Vol. 3, 28 Nov.-2 Dec. 2005, pp 1320-1324.
90. Kose C. and Wesel R. D., "Universal Space-Time Codes from standard trellis codes" , *GlobeCom 2004,* Dallas, TX, Nov. 29-Dec. 3, 2004, pp 391-395.
91. Shi J. and Wesel R. D., "Channel Eigenvector-Invariant Space-Time Constellations" , GlobeCom 2004, 29 Nov.-3 Dec. 2004, pp 530-534
92. Shi J. and Wesel R. D., "Universal Codes with Finite Block Lengths" , MilCom 2004, 31 Oct.-3 Nov. 2004, pp 1338-1344

93. Ramamoorthy A. and Wesel R. D., "Analysis of an Algorithm for Irregular LDPC Code Construction," ISIT 2004, Chicago, Illinois
94. Shi J. and Wesel R. D., "Rotationally Invariant Space-Time Constellations," ISIT 2004, Chicago, Illinois Shi J. and Wesel R. D., "Channel Eigenvector-Invariant Space-Time Constellations" *GlobeCom 2004*, Dallas, TX, Nov. 29-Dec. 3, 2004, pp 391-395.
95. Vila Casado A. I., Weng W. and Wesel R. D., "Multiple-Rate Low-Density Parity-Check Codes with Constant Block Length" , *Conference Record of Thirty-Eighth Asilomar Conf. on Signals, Systems and Computers*, Pacific Grove, CA, Nov. 7-10, 2004, pp 2010-2014.
96. Matache A., Jones C and Wesel R. D., "Reduced Complexity MIMO Detectors for LDPC Coded Systems" , MilCom 2004, 31 Oct.-3 Nov. 2004, pp 1073-1079
97. Ramamoorthy A. and Wesel R. D., "Expansion Properties of Generalized ACE Codes", *42nd Allerton Conference on Communication, Control and Computing 2004*, Monticello, Illinois
98. Weng W., Ramamoorthy A. and Wesel R. D., "Lowering the Error Floors of High-Rate LDPC Codes by Graph Conditioning," *VTC 2004*, September 2004, Los Angeles, California, pp 2549-2553.
99. Chan H., Hodjat A., Shi J., Wesel R. D. and Verbauwhede I., "Streaming Encryption for a Secure Wavelength and Time Domain Hopped Optical Network," *IEEE Intl. Conf. on Information Technology (ICIT) 2004*.
100. Ramamoorthy A. and Wesel R. D., "Construction of Short Block Length Irregular LDPC Codes,", *ICC 2004*, Paris, June 2004.
101. Ramamoorthy A., Shi J., and Wesel R. D., "On the Capacity of Network Coding for Random Networks," *Allerton Conference on Communication,Control and Computing*, October 2003
102. Jones C., Matache A., Tian T., Villasenor J. and Wesel R. D., "The Universality of LDPC Codes on Wireless Channels," *MilCom 2003*, Boston, MA, October 2003
103. J. Shi and R. D. Wesel, "Further Error Event Diagram Reduction Using Algorithmic Techniques," *International Conference on Communications (ICC) 2003*, Ankorage, AK, May 2003.
104. C. Kose, W. Weng, and R. D. Wesel, "Serially Concatenated Trellis Coded Modulation for the Compound Periodic Erasures Channel," *International Conference on Communications (ICC) 2003*, Ankorage, AK, May 2003,pp2953-2957.
105. T. W. Sun, R. D. Wesel, M. R. Shane, and K. Jarett, "Superposition Turbo TCM for Multi-Rate Broadcast," *International Conference on Communications (ICC) 2003*, Ankorage, AK, May 2003.
106. T. Tian, C. Jones, J. D. Villasenor, and R. D. Wesel, "Construction of Irregular LDPC Codes with Low Error Floors," *International Conference on Communications (ICC) 2003*, Ankorage, AK, May 2003.
107. C. Kose and R. D. Wesel, "Universal Space-Time Trellis Codes," *Globecom 2002*, Taipei, Taiwan, November 2002.
108. C. Jones, T. Tian, A. Matache, R.D. Wesel, and J. Villasenor, "Robustness of LDPC Codes on Periodic Fading Channels," *Globecom 2002*, Taipei, Taiwan, November 2002.
109. M. R. Shane and R. D. Wesel,, "Reduced Complexity Iterative Demodulation and Decoding of Serial Concatenated CPM," *International Conference on Communications (ICC) 2002*, New York, NY, April 28-May 2, 2002.
110. A. Matache and R. Wesel, "Trellis Coding for Diagonally Layered Space-Time Systems," *International Conference on Communications (ICC) 2002*, New York, NY, April 28-May 2, 2002.

111. C. Kose and R. D. Wesel,, "Performance of Likelihood Ratio Tests under Incorrect Models" *35th Asilomar Conference on Signals,Systems, and Computers*, Pacific Grove, CA, Nov. 2001.
112. M. R. Shane and R. D. Wesel, "Reduced Complexity Iterative Demodulation and Decoding of Serial Concatenated CPM," *35th Asil. Conf. on Signals,Systems, and Computers*, Pacific Grove, CA, Nov. 2001.
113. A. Matache and R. Wesel, "Trellis Coding for Layered Space-Time Systems," *35th Asilomar Conference on Signals,Systems, and Computers*, (invited) Pacific Grove, CA, Nov. 2001.
114. C. Komninakis and R. D. Wesel, "Trellis Turbo-codes in Flat Rayleigh Fading with Diversity," *Globecom 2001*, San Antonio, TX, November 25-29, 2001.
115. C. Fragouli and R. Wesel, "Bit vs. Symbol Interleaving for Parallel Concatenated Trellis Coded Modulation," *Globecom 2001*, San Antonio, TX, November 25-29, 2001.
116. C. Komninakis, R. D. Wesel, and L. Vandenberghe, "Capacity of the Binomial Channel, or Minimax Redundancy for Memoryless Sources," *IEEE International Symposium on Information Theory*, June 24-29, 2001, Washington D. C., page 127.
117. C. Fragouli, R. Wesel, Dirk Sommer, and Gerhard Fettweis, "Turbo Codes with Non-Uniform QAM Constellations," *International Conference on Communications (ICC) 2001*, Helsinki, Finland, June 2001, pp.70-73.
118. C. Kose and R. D. Wesel, "Code Design Metrics For Space-Time Systems Under Arbitrary Fading," *ICC 2001*, Helsinki, Finland, June 2001, pp. 1099-1103.
119. C. Fragouli, C. Komninakis, and R. D. Wesel, "Minimality Under Periodic Puncturing," *ICC 2001*, Helsinki, Finland, June 2001, pp. 300-304.
120. X. Liu, P. Ormeci, R. Wesel, and D. Goeckel, "Bandwidth-Efficient, Low-Latency Adaptive Coded Modulation Schemes for Time-Varying Channels," *ICC 2001*, Helsinki, Finland, June 2001, pp. 2211-2215.
121. W. Shi, C. Komninakis, R. Wesel, and B. Daneshrad, "Robustness of Space-Time Turbo Codes," *ICC 2001*, Helsinki, Finland, June 2001, pp. 1700-1704.
122. T. W. Sun and R. D. Wesel, "Constellation Labeling for Error-Resilient Source Coding of PAM," *35th Annual Conference on Information Sciences and Systems*, March 21-23, 2001, The Johns Hopkins University, Baltimore, Maryland, page 295.
123. M. Shane and R. D. Wesel, "Tight Bounds on the Mutual Information of the Binary Input AWGN Channel," *35th Annual Conference on Information Sciences and Systems*, March 21-23, 2001, The Johns Hopkins University, Baltimore, Maryland, page 117.
124. M. Shane and R. Wesel, "Parallel Concatenated Turbo Codes for Continuous Phase Modulation," (invited) *2000 Wireless Comm. and Networking Conf.,* Sept 24-28, 2000, 6 pages.
125. W. Shi, T. Sun, and R. D. Wesel, "Optimal Binary Distributed Detection," *2000 International Symposium on Information Theory*, Sorrento, Italy, June 2000, pp. 437.
126. R. D. Wesel and X. Liu, "Edge-Profile Optimal Constellation Labeling," *IEEE International Conference on Communications 2000*, New Orleans, LA, June 2000, pp. 1198-1202.
127. C. Komninakis, C. Fragouli, A. H. Sayed, and R. D. Wesel, "Adaptive Multi-Input Multi-Output Fading Channel Equalization Using Kalman Estimation," *ICC 2000*, New Orleans, LA, June 2000, pp. 1655-1659.
128. Q. Zhang, P. K. Varshney, and R. D. Wesel, "Optimal Distributed Binary Hypothesis Testing with Independent Identical Sensors," *2000 Conference on Information Sciences and Systems*, Princeton University, March 15-17, 2000, 6 pages.

129. C. Komninakis and R. D. Wesel, "Pilot-Aided Joint Data and Channel Estimation in Flat Fading," *Comm. Theory Symp. at Globecom 99*, Rio de Janeiro, Brazil, Dec. 5-9, 1999, pp. 2534-9.
130. C. Fragouli and R. D. Wesel, "Semi-Random Interleaver Design Criteria," *Communication Theory Symposium at Globecom 99*, Rio de Janeiro, Brazil, December 5-9, 1999, pp. 2352-6.
131. C. Komninakis and R. D. Wesel, "Non-Pilot-Aided Iterative Decoding for Joint Data Recovery and Channel Estimation in Fading," *33rd Asilomar Conference on Signals, Systems, and Computers*, Pacific Grove, CA. October 24-27, 1999, pp. 1122-1126.
132. C. Fragouli, C. Komninakis, A. H. Sayed, R.D. Wesel, "Channel Estimation and Equalization in Fading," *33rd Asilomar Conference on Signals, Systems and Computer*s, Pacific Grove, CA. October 24-27, 1999, pp. 1159-1163.
133. W. Shi, T. Sun, R. Wesel, "Optimal Binary Thresholds for Distributed Detection in Gaussian Noise," *33rd Asilomar Conf. on Sig., Sys., Comp.*, Pac. Grove, CA. Oct. 24-27, 1999, pp. 675-9.
134. K. Lakovic, J. Villasenor, and R. D. Wesel, "Robust Joint Huffman and Convolutional Decoding," *VTC-Fall-99*, Amsterdam, The Netherlands, September 19-22, 1999, pp. 2551-5.
135. C. Komninakis and R. D. Wesel, "Iterative Joint Data and Channel Estimation in Correlated Flat Rayleigh Fading," in proceedings of the *7th International Conference on Advances in Communications and Control*, June 28-July 2, 1999, Athens, Greece, pp. 385-390.
136. C. Fragouli and R. D. Wesel, "Convolutional Codes and Matrix Control Theory," in proceedings of the *7th International Conference on Advances in Communications and Control*, June 28-July 2, 1999, Athens, Greece, pp. 317-328.
137. R. D. Wesel, "Reduced Complexity Trellis Code Transfer Function Computation," in the *Communication Theory Miniconference in conjunction with ICC 99*, June 6-10, 1999, pp. 37-41.
138. C. Fragouli and R. D. Wesel, "Symbol Interleaved Parallel Concatenated Trellis Coded Modulation," in the *Comm. Theory Miniconf. in conj. with ICC 99*, June 6-10, 1999, pp. 42-46.
139. P. Ormeci, D. L. Goeckel, and R. D. Wesel, "Adaptive Bit-Interleaved Coded Modulation for Time-Varying Channels Using Outdated Fading Estimates," in proceedings of the *33rd Annual Conference on Information Sciences and Systems*, 6 pages.
140. H. Zou, H. J. Kim, S. Kim, B. Daneshrad, R. Wesel, W. Mangione-Smith, "Equalized GMSK, Equalized QPSK, and OFDM: A Comparative Study for High-speed Wireless Indoor Data Communications," in *1999 Veh. Tech. Conf.*, May 16-20, 1999, Houston, TX, pp.1106-10.
141. A. Bernard, X. Liu, R. Wesel and A. Alwan, "Embedded Joint Source-Channel Coding of Speech using Symbol Puncturing in Trellis Code," in the Proceedings of *ICASSP 99*, vol. 5, Phoenix, AZ, March 1999., pp. 2427-2430.
142. A. Bernard, X. Liu, R. Wesel and A. Alwan,"Channel Adaptive Joint Source-Channel Coding of Speech," Proc. *32nd Asilomar Conf. on Sig.., Sys, and Comp.*., Pac. Grove, CA, Nov. 98, pp. 357-361.
143. W. Shi and R. D. Wesel, "The Effect of Mismatch on Decision-Feedback Equalization and Tomlinson-Harashima Precoding," in *Thirty-Second Asilomar Conference on Signals, Systems, and Computers*, Pacific Grove, CA, November 2-5, 1998, pp. 1743-1747.
144. R. D. Wesel and X. Liu, "Analytic Techniques for Periodic Trellis Codes," in *Thirty-Sixth Annual Allerton Conf. on Communications, Control, and Computing*, Sept. 23-25, 1998, pp. 39-48.
145. X. Liu and R. D. Wesel, "Profile Optimal 8-QAM and 32-QAM Constellations," in *Thirty-Sixth Annual Allerton Conf. on Comm., Control, and Computing*, Sept. 23-25, 1998, pp. 136-145.
146. W. Shi and R. D. Wesel, "When the Best Decision Feedback Equalizer is a Linear Equalizer," in *Thirty-Sixth Annual Allerton Conference on Control, and Computing*, Sept. 23-25, 1998, pp. 338-39.

147. R. D. Wesel, X. Liu, W. Shi, and J. M. Cioffi, "Trellis Codes for Compound Periodic Gaussian Channels," in Proceedings of the *1998 International Symposium on Information Theory*, August 16-21, 1998, Cambridge, MA, pp. 462.
148. R. D. Wesel, X. Liu, and W. Shi, "Periodic Symbol Puncturing of Trellis Codes," in proceedings of *Thirty-First Asilomar Conf. on Sig., Sys., and Computers*, Nov. 2-5, 1997, pp. 172-6.
149. R. D. Wesel, C. Komninakis, and X. Liu, "Towards Optimality in Constellation Labeling," in proceedings of the *Communication Theory Mini Conference at Globecom 97*, Phoenix, AZ, November 3-8, 1997, pp. 23-27.
150. R. D. Wesel, and J. M. Cioffi, "Joint Interleaver and Trellis Code Design," in proceedings of *Globecom 97*, Phoenix, AZ, November 3-8, 1997, pp. 939-943.
151. R. D. Wesel, and J. Cioffi, "Fundamentals of Coding for Broadcast OFDM," in *Twenty-Ninth Asilomar Conference on Signals, Systems, and Computers*, October 30, 1995, pp. 2-6.
152. R. D. Wesel, and J. Cioffi, "Achievable Rates for Tomlinson-Harashima Precoding," *1995 International Symposium on Information Theory*, September 1995, pp. 399.
153. R. D. Wesel, and J. Cioffi, "Precoding and the MMSE-DFE," Invited paper in *Twenty-Eighth Asilomar Conference on Signals, Systems, and Computers*, November 1, 1994, pp. 1144-1148.
154. R. D. Wesel and R. M. Gray, "Bayes risk weighted VQ and Learning VQ," in *Data Compression Conference*, Snowbird, Utah, March 1994, pp. 400-409.
155. T. M. Cover and R. D. Wesel, "A Gambling Estimate of the Rate-Distortion Function for Images," in *Data Compression Conference*, Snowbird, Utah, March 1994 (abstract only).

BOOK CHAPTERS

1. H. Chan, A. Hodjat, J. Shi, R. D. Wesel and I. Verbauwhede, "Streaming Encryption for a Secure Wavelength and Time Domain Hopped Optical Network," Ch. 14 in Embedded Cryptographic Hardware (N. Nedjah and L. Mourelle, eds.). Nova Science Publishers, 2004

2. R. D. Wesel, "Convolutional Encoding" in *Wiley Encyclopedia of Telecommunications,* Edited by John Proakis, John Wiley, 2003.

3. R. D. Wesel, "Error Control" Chapter 6 in *Wireless Multimedia Communications,* Addison Wesley Longman, 1998.

PATENTS

1. R. D. Wesel, K. Vakilinia, S. Ranganathan, D. Divsalar, Haobo Wang, "High Throughput Communication System". U.S. Patent #10,374,759. August 6, 2019.

2. R. D. Wesel, K. Vakilinia, S. Ranganathan, D. Divsalar, "High Throughput Communication System". U.S. Patent #9998260. June 12, 2018.

3. R. D. Wesel, M-C. F. Chang, Y-M. Chang, A. I. Vila Casado, "Lower Complexity Layered Belief Propagation Decoding LDPC Codes". U.S. Patent #8489957, July 16, 2013.

4. A. I. Vila Casado, W.-Y. Weng, R. D. Wesel, N. Moschini, M. Siti, S. Valle, E. Yeo, "Variable-Rate Low-Density Parity Check Codes with Constant Blocklength". U.S. Patent #7802172, September 21, 2010.

5. I. S. Djokovic, R. D. Wesel, E. J. Infusino, M. K. Tsatsanis, "Multi-channel communication system for multiple input, multiple output processing of an encoded signal". U.S. Patent #7415086, August 19, 2008.

6. G. G. Raleigh, Michael A. Pollak, V. K. Jones, R. D. Wesel, "System and Method for I/Q Trellis Coded Modulation," U.S. Patent #6158041, December 5, 2000.

7. R. D. Wesel and J. M. Cioffi, "Transmission System Using Code Designed for Transmission with Periodic Interleaving," U.S. Patent #6125150, September 26, 2000.

8. R. D. Wesel, "Adaptive Frequency Dependent Compensation for Telephone Channels," U. S. Patent #5280525, January 18, 1994.

9. R. L. Daggett and R. D. Wesel, "Echo Protection Tone Detection and Regeneration for Digital Transmission of Facsimile Calls," U. S. Patent #5216519, June 1, 1993.

Exhibit C

DEPOSITION TESTIMONY OF RICHARD WESEL DURING PREVIOUS FIVE YEARS

Core Wireless Licensing S.A.R.L. v. LG Electronics, Inc. (2015, 2018) Case
No. 6:14-cv-911-JRG-RSP (E.D. Tex.) Lead Case
Case No. 6:14-cv-912-JRG-RSP (E.D. Tex.) Consolidated

Realtime Data LLC d/b/a IXO, v. Echostar Corporation, Hughes Network Systems, LLC (2018)
Case No. 6:17-cv-00084-JDL

Realtime Data LLC d/b/a IXO, v. Rackspace US, INC.; Netapp, Inc.; and Solidfire, LLC (2017)
Case No. 6:16-cv-00961-RWS-JDL (E.D. Tex.)

TQ Delta, LLC v. Comcast Cable Communications LLC, COXCOMM LLC and COX Communications Inc., DirecTV, LLC, Time Warner Cable, Inc. and Time Warner Cable Enterprises, LLC, Verizon Services Corp. (2016)
Case Nos. 15-611, 15-612, 15-613, 15-614, 15-615, 15-616 (RGA) (Delaware)

Core Wireless Licensing S.a.r.l. v. Apple Inc. (2016)
Case 5:15-cv-05008-NC (N.D. Cal.)

TQ Delta, LLC v. ADTRAN Inc. (2019)
Case 1:14-cv-954-RGA (D. Del.)

TRIAL TESTIMONY OF RICHARD WESEL DURING PREVIOUS FIVE YEARS

Core Wireless Licensing S.A.R.L. v. LG Electronics, Inc. (2016, 2019) Case
No. 6:14-cv-911-JRG-RSP (E.D. Tex.) Lead Case
Case No. 6:14-cv-912-JRG-RSP (E.D. Tex.) Consolidated

Core Wireless Licensing S.a.r.l. v. Apple Inc. (2016)
Case 5:15-cv-05008-NC (N.D. Cal.)